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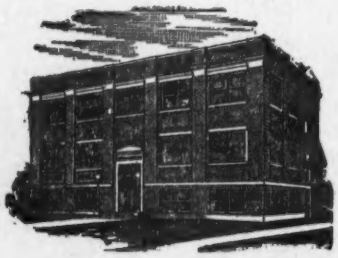

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EDITORIAL ANNOUNCEMENT

AT a special meeting of the Board of Regents of the American College of Surgeons, held in Chicago on December 20th, 1919, with the following Regents present: Dr. George E. Armstrong, Dr. George W. Crile, Dr. James B. Eagleson, Dr. William D. Haggard, Dr. Franklin H. Martin, Dr. Charles H. Mayo, Dr. Albert J. Ochsner, Dr. Alexander Primrose, and Dr. J. Bentley Squier, SURGERY, GYNECOLOGY AND OBSTETRICS was officially made what it has been informally for a long time—the official journal of the College. Its editorial staff will include Fellows of the College selected with the approval of the Board of Regents. Official announcements of the routine work of the College will be published each month in its own special department in the journal, this material to be sent to other leading medical journals in this country for simultaneous publication with SURGERY, GYNECOLOGY AND OBSTETRICS. Also under the direction of the College there will be printed in the advertising pages in each issue of the journal, a clinical bulletin of information, giving the names and addresses of secretaries in charge of clinical bulletin organizations in medical centers in the United States and Canada. These formal arrangements carry with them no financial responsibilty to the American College of Surgeons, but it is hoped that they may redound to the benefit of American surgery.

SURGERY, GYNECOLOGY AND OBSTETRICS

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PLASTIC SURGERY OF FACIAL BURNS[1]

BY MAJOR H. D. GILLIES, R.A.M.C., SIDCUP, ENGLAND

THE object of this paper is to place before the surgical profession the results of various plastic methods employed by the author for the relief of the distressing deformities and disabilities arising as the result of contractions following severe facial burns. While feeling that the methods, drastic as some of them are, are justified by the relief of symptoms, and by the very great amelioration of the disfigurement, the author must admit that, in the severest cases, he has seen as yet no perfect result. Parts of the restoration, say the eyelids, cheek or nose, may be as perfect as can be, but other parts will be defective and mar the total effect.

The author hopes that by criticism and development of his methods, others may advance the plastic treatment of these terrible deformities to a stage in which complete success will be the average prognosis.

GENERAL CHARACTERS

The character and extent of burn disfigurement vary directly with the direction of intensity and duration of the heat applied. The acid burn which splashes the face may be described as a collection of deep burns of small areas, joined by less severely affected, and even normal, patches of skin. Its duration of application is long but localized.

The airman's burn and the cordite burn directly follow the stated formula, but their appearance is greatly different owing to the differences in clothing. The head gear usually worn by the airman and by the gunner limits the extent of the burn. The airman is protected by his helmet and his scarf. The soldier gunner often has his tunic and cap on at the time of an explosion, while the sailor gunner has usually none of these protections.

All classes of flame burns show deformity of the eyelids in the form of a greater or less degree of cicatricial ectropion. It would appear that the eyelid skin, closed tightly to protect the vision, is the most vulnerable portion of the face. Certainly many cases have healed clear of all serious deformity except that a degree of ectropion of the lids remains. Coupled with a general pitting and paleness of the burned area this ectropion forms the first deformity to appear. With increasing severity other deformities appear; the whole facial skin is burned off down to the muscular layer leaving a ghastly scar, prominent points receiving more punishment than do the hollows; the skin of the nose is usually destroyed, while in the severest cases the bony framework of the nose covered by a scar, alone remains, the mucocartilaginous parts of the tip below the pyriform opening being involved in the destruction. Increasing destruction of the eyelids and of the ectropion occurs, until in the severest cases all layers of the lid are removed by the fire and the very eye burned out.

This extreme result has occurred in only one of the author's series of cases, while in one other the sight was permanently destroyed

[1]Read before the Clinical Congress of American College of Surgeons, New York City, October 20-24, 1919.

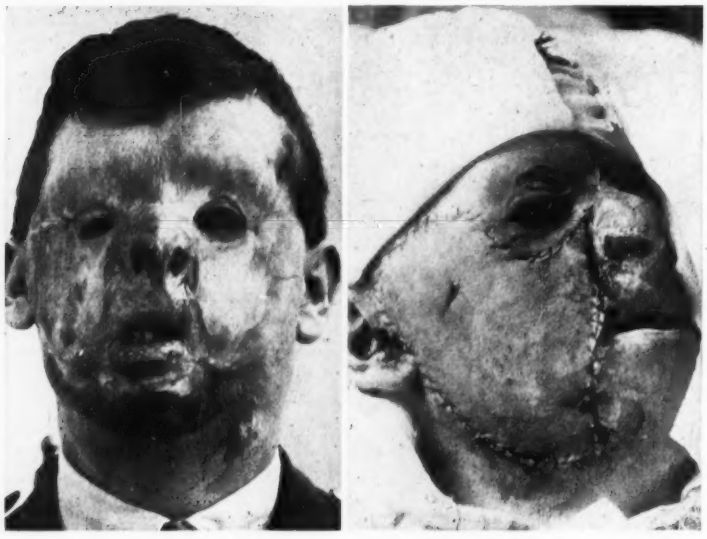


Fig. 1 (at left). Very severe airman's burn.
Fig. 2. Large Wolfe graft from buttock to right cheek, fourth day.

except for perception of light. Corneal ulcers are common. The eyebrows, forehead, and malar regions are vulnerable points; when the fire is sufficient to destroy the nose, the upper lip is burned and becomes ectopic, while usually the lower lip is similarly affected. Two types of contracture occur with the mouth. In one the angles are drawn backward in a permanent grin showing the teeth; in the other a ring of scar tissue closes the mouth to a small unyielding circle admitting only the tip of the thumb. In addition to the ectropion already described, a similar type of contracture occurs around the palpebral fissure.

A dense band of scar tissue sometimes appears at the inner canthus region, uniting the upper to the lower lid, and to the side of the nose, thus protecting the globe from excessive exposure. This epicanthus band is often so deep that it almost obliterates the normal hollow between bridge of nose and eye. When it is excised the true ectropion of the lids becomes evident, showing that a potential ectropion existed but was masked by this unyielding epicanthus band.

The skin over the prominence of the mandible is usually caught by the fire and tends to heal with marked keloidal scars (Fig. 16). When the neck is burned it shows either isolated keloids or vertical bands perverting extension of the head.

The pinna is one of the most vulnerable points when not protected, the helix alone covered by a poor quality of regenerated skin being left in the worst cases.

VARIETIES DUE TO PROTECTION

The *airman's burn* presents a clear clinical picture owing to the leather helmet, cheek, and chin straps, and the muffled neck; the area of deformity is strictly limited within this mask. A clear-cut line of demarcation follows closely where the helmet and cheek straps have been. The neck and chin escape except where metal trickles touch the neck. Here keloids are seen. The ears are never attacked.

The *cordite burn* shows no special line of demarcation. The ears are always burned, while the area of the neck involved depends on the clothes the victim was wearing at the time. Thus, a sailor case showed the largest extent, as during action he had no protection above the clavicle.

Acid burns are limited to the area splashed.

Household burns and burns during epileptic fits depend for their extent and severity on obvious local factors. An epileptic will lie with part of his face on a red hot bar until the area in contact is very deeply involved.

In the two main varieties of burns from flame the hands are always burned as they are instinctively applied to the face with the dorsal surface to the flame. It follows that contractures of the extensor mechanism is frequently met with (Figs. 4 to 9).

TREATMENT

Early. The author has no data on which to hazard an opinion as to the best early treatment, nor as to the origin of true keloid and of excessive scar-tissue formation.

Intermediate. In regard to the intermediate stage when the burn is healed and the scar active, measures to reduce fibrosis are indicated. Good results appear to have accrued in some cases from diathermy, ionization, massage, and protection by a greasy mask.

The filtered X-ray and its more potent colleague, radium, can reduce scar tissue to a minimum, but in so doing so much radiation penetrates the deeper structures causing atrophic changes that the advisability of its full use in a case that obviously will require major surgical repair, is extremely doubtful, as its use may seriously militate against surgical success. The balance in favor of success is so lightly held in this class of repair that such preliminary treatment producing avascularity, cannot but be viewed askance. When surgical treatment is not in view, then the use of rays or radium is indicated where the scar tissue is excessive. An exception to this procedure appears advisable in isolated keloidal scars, which may be excised locally. Here it is the author's practice to subject the scar to rays before and after excision, since, in the absence of any necessity for large flap or graft operations, the question of tissue vitality does not arise.

Final or plastic. The best time to commence the plastic treatment proper would appear to be about the time the scar has ceased contracting, a point not always determinable, often not occurring for a year or more.

At any time during this stage if there is excessive exposure of the cornea from ectropion, corneal ulceration may develop and may necessitate an emergency operation to give protection. Flaps of scar tissue and various grafts have been utilized to cope with the condition, but as a rule they are temporary measures and form no part of the final make up.

The general *plan of reconstruction* must now be formulated, the first essential of which is an accurate determination of the tissue that has been lost. In this connection allowance must be made for the release of the normal tissues occurring when the binding scar has been excised. Except as regards the nose and ear, this resolves itself usually into an estimation of the loss of skin covering only, neither the mucous membrane cavities nor bony framework being involved. As far as it is possible to generalize the procedure adopted in a series of cases, each of which has had to be treated individually, the author's practice is as follows:

A male patient requiring complete facial replacement presents himself for treatment.

1. The forehead is replaced by a Wolfe graft.

2. The eyebrows are grafted by taking a strip of the scalp from over the mastoid region. The strip has to be so deep as to include the hair follicles. The strip from the left mastoid goes to the left eyebrow, and the right to the right in order that the hairs should grow in the right direction (Fig. 33).

3. Movable eyelids are provided by the author's "epithelial outlay" operation, which is an adaptation of the Esser inlay. This method of skin grafting is usually applied also to the inner canthus region.

4. The nose is renovated by a Wolfe graft. To complete the lining and support of the new tip and alæ destroyed, parts of the scar tissue overlying the margins of the defect are cut into suitable flaps and inserted so that their epithelial surface forms the lining of the vestibule. The flap is stiff enough with its cartilaginous remains and fibrous tissue to form adequate support for the new tip and alæ. Remaining scar tissue is excised and the Wolfe graft applied over the whole raw area. Instead of a graft its place is preferably taken

Fig. 3. Abdominal flap to dorsum of burned hand.

by a *flap*, when such is available. The skin of the flap comes from the chest or neck, and is usually part of a tubed pedicle which is being used for the remaining replacement. Flap skin is better in appearance than successful Wolfe graft skin, and lends itself better to shaping and retouching operations.

5. The upper lip is revived by a whole depth hair-bearing graft from the scalp region, similar to the eyebrows, care being taken to secure correct line of hair growth.

6. The cheek, chin, and lower lip replacement is made by transferring in stages a large flap of skin from the neck and chest. Both sides of the face may be attacked simultaneously or separately, according to the constitution of the patient, or to local considerations. The line of replacement aimed at commences at the vermilion border of the lower lip, out to the angle of the mouth, up the nasolabial fold and side of nose, along the infra-orbital ridge to link up with the existing grafts, across malar and zygoma, down in front of the ear, and along the border of the mandible, according to the lateral and inferior limits of the scar.

When available in sufficient size, the author's retro-auricular flap gives the best results in cheek replacement on account of the affinity of this skin to that of the face. In Figure 14 the perfectly natural character of such a new cheek may be observed. No chest skin, even after bronzing in the sun, has as yet given a natural looking face skin, as it is inclined to be dry, pale, and lacking in surface vessels.

These large flaps, especially the tubed pedicle ones, involve a multiplicity of operations which, coupled with the indicated intervals of convalescence, stretch over a period of one to two years. To reduce length of treatment and multiplicity of operations, the author is now tentatively employing larger and larger Wolfe grafts, even to movable parts such as the cheek. Over the firm parts, such as the forehead and nose, uniformly good results are being obtained with these large grafts, but as yet in the cheek and chin cases the outcome is problematical. One such large Wolfe graft replacing the right cheek is illustrated (Figs. 1 and 2). Parts of this graft broke down and failed to perish as a Wolfe graft. More than 60 per cent of it, however, took as if it were flap skin, and the remaining portions epithelized over as if a Thiersch graft had been applied. A final good result is now assured, although the case is incomplete and many months of treatment have been saved.

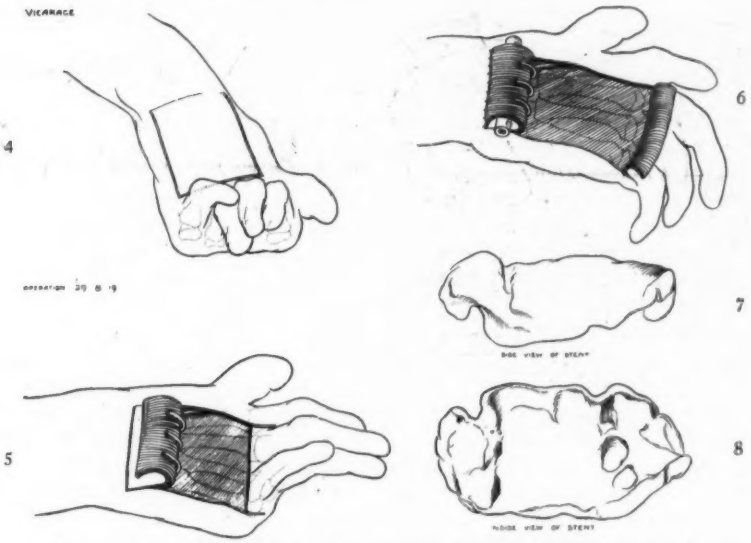
7. The ear is a separate problem, usually neglected in severe burns on account of the length of time taken in doing the more important facial repair. The ordinary principles apply, viz.: two layers of skin enclosing shaped cartilage are grafted by stages into the required position.

8. The hands. Scar tissue should be replaced by healthy skin in all cases, transferred there by the abdominal method or by the author's tubed pedicle method, or by Thiersch grafting. The shortened extension tendons may be lengthened by a kinematic operation coupled with grafting as indicated in the illustrations and diagrams (Figs. 4 to 9).

METHODS EMPLOYED AND THEIR TECHNIQUE: FLAPS, WOLFE GRAFTS, THIERSCH GRAFTS

Flaps. Two areas from which to draw the necessary skin for replacement by flaps present themselves: (1) from beneath the mandible and behind the ear, and (2) from the neck-chest region.

1. The special advantages of the post-auricular flap have been noted above. It is not available when there is scarring in the



Figs. 4 and 5. Incision and flap with extensor tendons for kinematization of three inner digits.

Fig. 6. Epithelial tube completed. Metacarpophalangeal joints opened to release the three fingers.

Figs. 7 and 8. The impression of the whole raw area taken in dental compound or "stent," on the under surface of which the Thiersch grafts are applied. Drawn by S. Hornswick.

carotid triangle area of the neck, and is not wide enough in those cases in which there is a narrow area of non-hairy skin between the pinna and the scalp. The author widens it by turning the pinna forward and reflecting the skin off the posterior surface as part of the flap (Figs. 10, 11, 12). It is further widened by including scalp proper. This backward extension, however, is dangerous if extensive, as it is found that the scalp portion declines association with the thin skin over the mastoid. There would appear to be a weak anastomosis between the vessels of the two areas, though each is richly endowed from its own supply. The incisions necessary to make such a flap are sufficiently clearly designated in the diagram to require no special description (for examples see Figs. 13 and 14).

2. Skin from the neck-chest region may be transported to the face in two main ways: (a) direct with the pedicle embedded as part of the flap, or (b) by stages, the pedicle being tubed.

a. The two methods are combined with advantage in some cases, the replacement being direct while the pedicles are tubed at the time of operation (Fig. 27).

The direct method has the value of shortening the process, but is more severe on the patient generally, and on the flap in particular. In Figure 15, the whole of the right cheek of

Fig. 9. Early result. Note perfect epithelization of area, including the articular surfaces, improved position of digits, appliance ready for attachment of artificial tendons so that dorsiflexion may be possible.

Figs. 10, 11, and 12. The author's postauricular flap for cheek replacement. Drawn by S. Hornswick.

the patient has been replaced by the large ascending neck-chest flap now seen in position. This flap gave much anxiety and appeared to slough in many places. The final result, however, justifies the severity of the procedure. The base of such flaps has to be very wide.

b. The *tubed pedicle* method is one that was propounded by the author in September, 1917, when he was first confronted with the most severe type of facial burn. Its primary object was to protect the pedicle from infection and exposure during the healing of the flap proper on the face. It then became apparent that such a tubed pedicle made in a preliminary stage would develop a richer vascular communication to the flap proper. This expectation was realized and it became possible to reduce the width of the pedicle and its base (see Figure 22 in which the pedicles were tubed in the first instance and have narrow bases).

Speaking generally, the process is as follows: The base of the pedicle lies at the upper part of the neck, and is 2¼ to 3 inches in width. Two parallel cuts are now made down the neck, and over the clavicle. Here the area to be transferred to the face commences to be marked out, and of course varies with the type of reconstruction in hand. Where the area is very large it is indicated to attach two pedicles to it, one on each side of the neck, the flap proper being situated centrally (Fig. 22).

On one occasion the author designed four tubed pedicles to a very large flap; the whole procedure, however, was ill judged on account of the patient's general condition, and disaster befell both the flap itself and the patient.

In the first stage of an ordinary tubed pedicle, the area of neck skin outlined by the incisions described above, is raised by undercutting until it is quite free except for its upper base attachment, and for its lower or flap attachment. The two skin edges are now turned forward toward each other and toward the neck, adapted and sewed accurately together by continuous suture. The tube being made, the margins of the defect so caused are freely undercut until approximation can be effected beneath the pedicle (Figs. 16 to 20). Tension sutures are necessary to prevent breaking down of this wound. The author usually employs a deep near-far-far-near catgut suture together with button protected silkworm mattress sutures for this purpose (Fig. 16). Purchase from the periosteum of the clavicle is used to pull forward the posterior triangle of skin by catgut sutures, helping also thereby to obliterate an unpleasant hollow which develops just above the clavicle. Approximation is aided also by manipulation of the shoulder and head. When primary closure of the secondary wound is not obtained, Thiersch grafting is indicated.

When the next or second stage occurs (any time after three weeks) the flap proper is outlined and raised from the chest and grafted to the required area of the face. The secondary raw area is treated similarly to that of the neck.

Fig. 13.

Fig. 14.

Figs. 13 and 14. Airman's burn, very severe. Cheek replacement by postauricular flap.

It is to be recognized that in all cases of tubed pedicle, the blood supply to the tube after the first stage may be coming mainly through the chest or lower end. Hence it follows that in the second stage when this supply is cut off, sloughing troubles are to be met with. To circumvent this danger, the pedicle and its flap may be further prepared by undercutting the chest attachment by partly tubing the flap proper or by circumscribing the area of skin with a knife, some days prior to the second stage. The best basis of blood supply for the pedicle would appear to be those situated high in the neck in the submaxillary triangle where the anastomosis of the transversalis colli and suprascapular vessels come into play. In order to improve the vascularity at the base, the author has deliberately shifted the base of the pedicle to the submandibular in order

Fig. 15. Cordite burn. Right cheek replaced by neck-chest flap. Broad pedicle embedded.

to secure a richer flow of blood. This carried out in one case enabled the second stage to be successfully accomplished, when its success seemed in jeopardy owing to the fact that in the healing of the tube pedicle stage, trophic troubles made their appearance about the center of the pedicle. The principle of moving the base on to a more vascular area underlay in the first place the retro-auricular flap above described. It was first intended to act as the base of a tube pedicle running down the neck; but in the case in which it was used the flap was extended sufficiently to include the pinna and mastoid skin so as to effect a complete restoration.

In the third and subsequent stages in which the pedicle itself is swung up to the face on the new facial blood supply, in only one case has there been any deficiency of nutrition to the transplant.

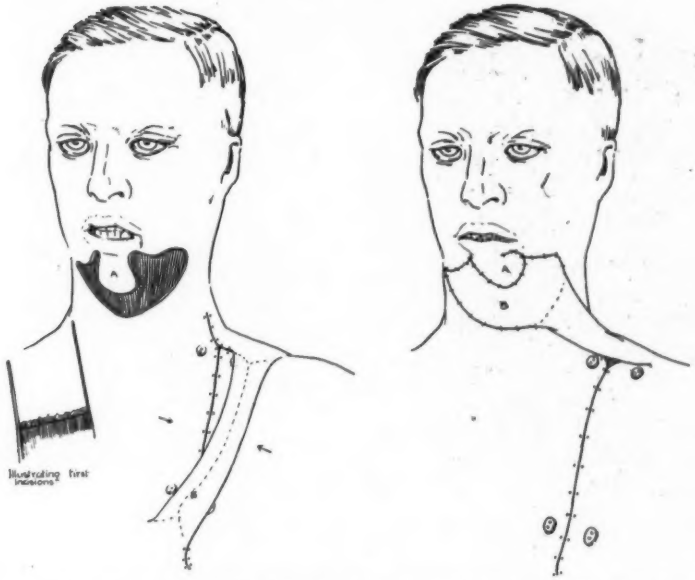
The third stage consists in the disposal of the pedicle. Two courses are usual. In one the pedicle is cut close to the face and replaced into the opened out wound of the neck (Figs. 21 to 25); in the other the pedicle is cut close to the neck attachment and swung up to the face (Fig. 20). It is usually long enough to cover a new nose or to make any portion of the face below the eyes. It stands kinking well, as it is found that the new blood supply into it, coming from the facial anastomosis, is better than its original neck supply. Further, if long enough it may be shifted a third or fourth time, using either end as its base of supply. Thus the author has made a nose out of the neck end of the pedicle, has cut it off after a due interval below the new nose, and has spread the balance out over the cheek. In another case with bilateral pedicles the left one was swung around to make a nose, while the right was spread out to make a cheek (Figs. 26 to 33).

In all cases of pedicle utilization, the part to be grafted has to be untubed and flattened out. This is easily effected, if no infection of the pedicle has ever occurred during its existence, by simple excision of the small scar where union of the edges has taken place, coupled with the removal of a central core of thickened tissue, which varies from a negligible quantity to quite a thick strand. If this core be not removed the skin of the pedicle will not flatten out satisfactorily.

In regard to shrinkage of the skin in the pedicle, very little would appear to occur where the final spreading out of the skin is made with adequate tension, equal to that which it possessed in the neck before interference. A small amount of skin is lost in the intubing process normally, more when infection occurs in the exceptional case.

(If it is desired to make a whole new lip, as in a gunshot injury, the pedicle is not opened out but grafted as such, so that a double epithelial surface results with a prominent edge and smooth contour.)

The author wishes to point out the value of the tubed pedicle principle in those cases of limb contractures from burns or other causes, in which it is a desideratum to graft large plaques of body skin over the scarred area. It has fascinating possibilities in the reconstruction of the penis and the breast, and when made in the reverse and covered by epithelial grafts may be utilized some day to convey food from the pharynx to the stomach. Manipulation would have to take the place of the swallowing movements. Extensive œsophageal operations might thereby be facilitated or made practical.



Figs. 17 and 18. Diagrams of Stages 1 and 2. First stage (at left): Four inch parallel chest flap tubed. Complete closure by advancement. Second stage: excision of scar tissue for reception of lower extremity of flap *B*, Fig. 18. Flap *A* swung to left. Chest flap partly untubed and sewn into place. Drawn by Lieutenant A. Lindsay, A.A.M.C.

FIG. 16.

Fig. 16. A neck-chest tube pedicle which has been prepared for replacement of a keloid scar along the mandible. First stage.

FIG. 19.

Fig. 19. Early result, third stage.

FIG. 20.

Fig. 20. Later result, third stage, showing improvement in junction line with face.

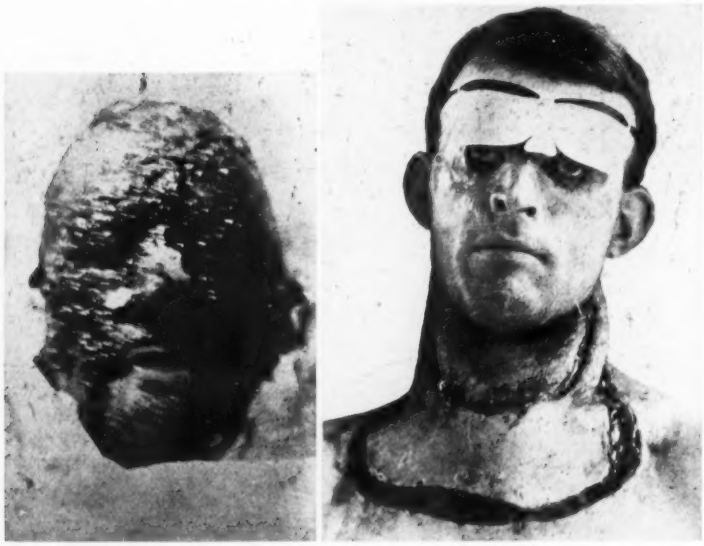


Fig. 21 (at left). Cordite burn, soon after injury in Battle of Jutland.
Fig. 22. Healed with very severe ectropion and upper facial burn. Bilateral tube pedicles to chest flap, first stage.

The Wolfe graft. The present position, as far as the author knows, of this method of supplying skin to the face shows promise of a more extensive field of usefulness. When successful, the character of the new skin would not appear to be as cosmetic as flaps of skin. The latter is transplanted with its glandular element intact, while the typical

Fig. 23. Fig. 24. Fig. 25.

Fig. 23. Second stage, pedicles and flap in position.
Fig. 24. Third stage, pedicles opened and returned to neck. Note development of facial expression lines, a free blush was present in this graft in the third week.
Fig. 25. Six months after first operation. Note grafts to eyelids and adaptation of flap to its new position. Artificial eyebrows.

Fig. 26 (at left). Total facial cordite burn. Battle of Jutland.
Fig. 27. Large chest flap applied to face with two tube pedicles. The skin over the nose has sloughed. The left pedicle has been divided.

Wolfe skin undergoes considerable mutilation on its deep surface during the process of its removal. At first the differences in the two transplanted skins bear out this proposition, but in the course of time become less marked. Skin, when taken either from the trunk or from an extremity, never really develops the characters of the facial covering, but critical sensation, pigmentation lines and even blushing are observed in such transplants. There remains an absence of bloom, a coldness of color, conditioned by a deficiency of glandular content, of pigment, and of superficial vascularity.

Successful Wolfe grafting may now be predicted when applied to such firm areas as

Fig. 28. Fig. 29. Fig. 30.

Fig. 28. Both pedicles divided. Note ectropion of eyelids.
Fig. 29. Method of converting the left pedicle into a nose. A suitable epithelial lining was provided for the new tip and alæ. Drawing by Prof. H. Tonks.
Fig. 30. Left pedicle swung to the nose.

Fig. 31.

Fig. 32.

Fig. 33.

Figs. 31 and 32. Final stages. The right pedicle has been spread out over the cheek. The new nose has been trimmed and supported by cartilage. Four new eyelids have been provided by an "outlay" operation. New eyebrows have been grafted.

Fig. 33. Illustrating functional cure of ectropion.

the forehead and nose. Skin edges must be accurately sutured. It would appear that tension of the grafted skin should be equal to that of the area from which it is removed. An exact tailor's fit should be aimed at, so that even tension exists throughout. It follows that to cut the graft larger than this "to allow for contraction" is a proposition obsolete both in theory and practice. The author is of the opinion that holding a flap or graft on tension is beneficial to its success by virtue of keeping open the tiny spaces through which anastomotic processes may occur and tissue fluids come and go.[1]

A case has already been mentioned in which the whole cheek was replaced by a large graft (Fig. 2). In another case the graft was a distinct failure, patches only of it persisting while the areas epithelized over. The deformity as a whole has not thereby been reduced. A flap operation is now indicated.

Pressure as well as tension is applied to a Wolfe graft so that the new skin is firmly pressed on to its new bed until adherence has taken place. Collections of blood and body fluids are thus prevented from collecting under the graft. *Application* of the pressure is secured without difficulty on the forehead. On the nose one method entails the use of a molded splint made of dental modelling composition, which is in its turn held in place by strapping by a spectacle frame, or best by a splint taking its fixation point from the upper teeth. On the cheek and chin, pressure is applied with difficulty. In any case a dental appliance carrying an arm to press the mold on to the graft is indicated. Further, a splint fixing the mandible in the open bite position will inhibit most cheek movements, while the head itself may be secured by a jury mast. Another and effective method of graft fixation is illustrated in Figure 34, in which a large Wolfe graft was applied to the lower lip and chin, and pressed there by a mold of dental composition, which is itself fixed by cross sutures from areas beyond the margin of the graft. In Figure 34 little rolls of gauze were used to prevent cutting through of the retaining sutures.

Thiersch grafts. For burned faces the Thiersch graft finds its best use when applied to the eyelids by the author's epithelial outlay operation. This was described by him before the Ophthalmological So-

[1] To cut a forehead flap in rhinoplasty one-third larger than pattern is, in the author's opinion, entirely wrong. It should be cut to an exact pattern so that natural moderate tension occurs in its new position.

Fig. 34. Wolfe graft to chin, "stent" or dental mold composition pressing the graft on to its bed.

ciety of England in May, 1918.[1] Its principle depends on the method of skin grafting described by Esser as the epithelial inlay, which was designed for entropic conditions. The author modified it for ectropic conditions.

Technique for upper lid ectropion follows (Fig. 35): To deal with the deep scar tissue that usually exists between inner canthus region and nose, an extension of the skin graft is carried from either upper or lower lid operation. In other cases a separate graft at a later stage is placed over this area, and pressed into position by a crescentic shaped mold which is only partly buried.

The results of the outlay operation, both in appearance and function, are uniformly good in all cases of ectropion, except that class in which the musculature of the lids has been destroyed by fire. Improvement only is to be expected here. Disappointment also must be anticipated when a graft is applied to a bed, the tissues of which are still undergoing contractile fibrotic processes. The graft at first appears perfect and adequate, but as the underlying tissue contracts the graft shrinks with it. Such failure must not be attributed to the graft or to the method, but to the choice of operation time. In the interests of the patient's eyesight, such a too early operation may have to be undertaken, but an emergency covering to the lid is better found by using a forehead or cheek flap if available.

[1] Tr. Ophth. Soc. of England, 1918, May.

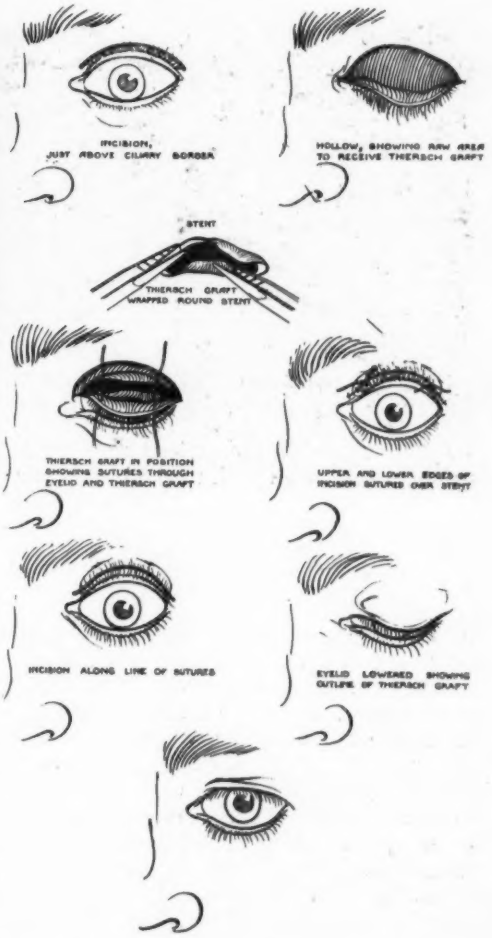

INCISION, JUST ABOVE CILIARY BORDER
HOLLOW, SHOWING RAW AREA TO RECEIVE THIERSCH GRAFT
STENT
THIERSCH GRAFT WRAPPED ROUND STENT
THIERSCH GRAFT IN POSITION SHOWING SUTURES THROUGH EYELID AND THIERSCH GRAFT
UPPER AND LOWER EDGES OF INCISION SUTURED OVER STENT
INCISION ALONG LINE OF SUTURES
EYELID LOWERED SHOWING OUTLINE OF THIERSCH GRAFT

Fig. 35. Diagram of the author's "epithelial outlay" operation. Modified from Esser. Drawn by S. Hornswick.

Other practical failures of this operation are due to failures of technique arising from non-observance of the following points: The graft should be well and evenly cut in one piece (thick grafts are not contra-indicated except that they are more difficult to handle); every part of the mold must be covered by the graft which should be gently stretched over it so that no wrinkles or excess skin remain. (Examples of the outlay operation are illustrated in Figure 36.)

Fig. 36. A typical case treated by the "epithelial outlay" operation. Cordite burn with very severe cicatricial ectropion.

After-treatment in the various methods described, differs with each method, as well as with each individual case. The Thiersch graft requires none until the removal of the mold, 7 to 10 days; Wolfe grafts have the pressure maintained for 3 to 5 days as a rule. After this the state of the transplant determines the treatment. Hot saline dressings promote circulation in the new graft, but cases also do well when no dressing is applied. Inflamed areas around stitches should be instantly dealt with, and collections of fluid expressed.

As early as the third day it is possible to label portions of the graft as definitely taken, while it may be as late as the tenth day before a definite circulatory life appears in other parts of it. In other parts again, the superficial epithelium alone desquamates, while complete failure can only be recorded when the graft comes away as a black layer in its entire thickness.

In regard to large flaps of doubtful vitality much of the above applies, but the most successful method of treating such a flap would appear to be by keeping it warm and moist, from the time of operation until the danger is past. Thus the circulation in the end vessels and spaces is aided so that stasis and thrombosis do not so readily occur.

In the efficient fixation of the graft, and in the artificial promotion of its circulatory activity by warmth, electricity, or chemical processes, lie the promise of progress in successful Wolfe grafting.

GUNSHOT FRACTURE OF THE FEMUR[1]

By SIR ANTHONY BOWLBY, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., London

GUNSHOT fracture of the femur occurs in about one and a half per cent of all wounded men. It is one of the most dangerous injuries of war, but it must be realized at once that the danger is proportionate to the extent and nature of the injury of the soft tissues even more than to the extent of the bone lesion Thus, it is well known that a spent bullet which glances off the femur and just breaks it may cause a minute entry and exit wound and a fracture which is much more like a simple fracture than a compound one. On the other hand, a large shell fragment may tear away the greater part of the hamstring muscles and the skin covering them, and may inflict so severe an injury that even if the femur is not fractured, the lesion of the soft parts alone may well prove fatal.

In the South African War of 1899 to 1902, it was the former class of fracture which predominated, for, not only were there very few high explosive shells used, but the rifle bullets were generally fired at a range of over 1000 yards and were of a shape which caused the minimum of injury to the soft tissues and the very smallest wounds of entrance and exit. It thus happened that the majority of cases did well, and that the experience of fracture of the femur in the South African War was of but little help in 1914, although it did demonstrate very clearly the value of the "Hodgen" splint, and its superiority to the time-honored "Long Liston."

In the recent war, fractures of the femur were generally inflicted either by wedge-like bullets fired at quite short range from machine guns, or else by fragments of high-explosive shells which were often very large, being parts of shells which themselves weighed from 60 to 200 pounds or more. Extensive tearing of the muscles was therefore the rule, and in many cases the patient had other wounds in addition. In the early days of the war, shrapnel shell was extensively used by the Germans, and it was much used by both the British and the French throughout the whole war. The lower velocity of its round bullets caused it to produce much less injury to bone and muscle, than the rifle bullet fired at short range or than the fragments of high-explosive shell.

Another very important factor to be considered in estimating the danger of fracture of the femur is the length of time that is often liable to elapse before the patient can be adequately treated. If in France a man were wounded in our own trenches or in billets there was very little delay, but, on the other hand, if he was wounded in an attack on the enemy's position it was often impossible to attempt to move him until nightfall, and he could not, of course, help himself to get to an aid post. The result was that before the patient could be treated he was often weakened by continued bleeding, by hunger and thirst, or by exposure to cold through lying out in mud and water, or through being soaked by heavy rain.

Conditions such as these will always cause a very high rate of mortality, whatever treatment is adopted.

TREATMENT

The treatment of these fractures falls naturally into two divisions: first, treatment at the front; second, treatment at the general hospitals.

TREATMENT AT THE FRONT

At the beginning of the war the splints supplied at the British front were very inefficient as well as very few, for the only splints available were long wooden splints of the Liston type, but both too thin and too narrow to be satisfactory. A rifle made a better splint. Within a few months I was able to obtain supplies of stouter splints made with a metal bracket 8 inches long so as to permit access to the wound, and these proved very serviceable and were employed for nearly a year and a half at the aid posts and field

[1]Presented before the Clinical Congress of American College of Surgeons, New York City, October 20, 1919.

ambulances. In 1915, Colonel Max Page devised a splint made of flexible metal and of the "Thomas" type, and by the end of the same year Sir Robert Jones's advocacy of the "Thomas knee splint" had resulted in its employment in many units. At about the same time, Sir Cuthbert Wallace, in conjunction with Colonels Richards and Frankau, perfected the now well-known "stretcher-suspension-bar" which enabled the patient to be carried on a stretcher with the lower extremity suspended. The use of the Thomas splint was soon adopted throughout the entire front and was demonstrated by the consulting surgeons in every field ambulance in the British Army. The application of what came to be called the "Thomas outfit" (i.e., Thomas knee splint and suspension bar) was also taught to all the field ambulance orderlies and regimental stretcher bearers, and it was further ordered that when a man with a fractured femur was found on the battle field the splint was always to be applied before the trousers were cut open or the wound dressed, and that the boot should also be left on the foot. The object in view was to immobilize the fracture before the limb was much handled, and also to apply the splint with as little loss of time as possible. A back-splint or a kettle-holder splint was often applied in addition.

When the use of the "Thomas outfit" became general the transport of the patient to the casualty clearing station was very greatly simplified, for, as soon as the limb was fixed in extension and slung, pain was either altogether prevented or reduced to a minimum, bleeding was soon checked and the steadying of the fragments effectually prevented further injury to the soft tissues and the spread of sepsis. The consequence was that patients arrived in infinitely better condition than previously, and shock was no longer so serious. The value of this early splinting of fractures was unexpectedly demonstrated when in May, 1918, several French Divisions came to the Kemmel area. Their journey had been hurried, and efficient splints had not been provided, so that when fighting began many patients arrived in British casualty clearing stations with fractures unsplinted. The condition of these men was an object lesson to those who had not been at the front in the earlier days of the war, for evidence of shock and loss of blood predominated in them, while the cases arriving at the same casualty clearing station from the British field ambulances were in good condition. The necessary splints were at once provided.

The method I have sketched of applying first-aid treatment to cases of fractured femur was not materially altered in the British Army during the last two and a half years of the war. It is, of course, very probable that further improvements will be developed, but it appeared to us when hostilities came to an end that for the time being we had found a very efficient method of treating these fractures on the battle field.

We found that the best means of applying traction on the field was by steel calipers fixed to the sole of the boot below the instep. In the absence of these a steel skewer may be passed through the boot leather, but has the disadvantage of spoiling the boot. Either a clove-hitch bandage or a so-called "surgical spat" was liable to cause too much pressure on the thin skin of the dorsum of the foot and consequent sloughing if left on for long.

On arrival at the casualty clearing station the routine treatment was to anæsthetize the patient, then take off the splint and dressings, and thoroughly remove with knife and forceps all damaged tissues and foreign bodies. Before this could be done it was often necessary to employ measures to combat shock or loss of blood, and in most cases gas and oxygen were the anæsthetics for choice.

After the operation was completed the Thomas splint was again applied, but this time the extension was fixed to the skin by strapping or glue. Then, as soon as the patient's condition permitted, he was removed to the ambulance train, en route for the general hospital area

Primary amputation. In a large number of cases of fracture of the femur, primary amputation is absolutely necessary and should be performed as soon as the state of the patient permits. In the latter half of the war, the employment of improved methods of transport and of resuscitation enabled amputation

to be performed on many more patients than in 1914 and 1915.

The conditions which commonly necessitate early amputation may be briefly summed up as follows:

1. Complete smashing of large area of bone.
2. Extensive comminution of the lower articular end of the femur.
3. Laceration of the femoral vessels.
4. Extensive destruction of muscles or skin.
5. Gas gangrene.

It must be recognized that primary amputation for fracture of the femur is attended with a very much higher death rate than is amputation in the thigh for injuries of the leg, and also that the higher up the limb is removed the greater is the mortality. Primary amputation at the hip-joint is so uniformly fatal that it had better not be performed at all.

TREATMENT AT THE GENERAL HOSPITALS

The first duty of the general hospital surgeons was to operate on those cases which had not been operated upon at the front, and at the end of March, 1918, when all the casualty clearing stations of the Third and Fifth Armies had been forced to retire, the bulk of the operating work fell to the lot of the general hospitals. If, however, thorough excision had been satisfactorily performed at the front in good time, as was usually the case, then the patient on arrival was put to bed and allowed to remain undisturbed for a day or two, to recover from all he had gone through. During this period many patients improved very rapidly in every way.

In many cases, after this period of rest, another apparatus was substituted for the Thomas splint, and in the putting up of these fractures an immense amount of ingenuity and skill was developed throughout the whole of the bases in France. The names of Major Sinclair and Major Pearson must be given a special place in this relation because they were the earliest and most ingenious of the pioneers, but many other surgeons became equally deserving of distinction subsequently.

The details of the methods employed have been so well described and illustrated by various surgeons, in the *Journal of the Royal Army Medical Corps*, in the *British Journal of Surgery*, and elsewhere, that it would serve no good purpose if I were to follow in their footsteps. I will, therefore, only attempt to indicate the general principles which were common to most centers, merely premising that the greatest benefit and progress resulted when, at the end of 1917, certain hospitals in every area were specially selected and equipped for the treatment of fractures of the femur, and when the surgeons of these hospitals had acquired experience in the work.

PRINCIPLES OF TREATMENT

First. The first general principle which was universally adopted was that the apparatus employed should be a skeleton metal splint, and that this should be used so as to enable traction to be applied either directly downward or else in various degrees of abduction or flexion. This was the essential foundation upon which all else was based.

Second. The direction of the traction and the amount of flexion or abduction required were guided throughout by frequent roentgenograms. These were always taken by a movable X-ray apparatus brought to the side of the bed, and by the aid of these the position of the fragments was altered, so as to obtain accurate apposition. Without the frequent use of X-rays at the bedside it is not possible to obtain uniformly good results.

Third. The length of the limb was at first measured daily and afterward less frequently, and it was found most useful to keep a "chart of shortening" (or lengthening) over the patient's bed. It became the custom to apply extension until the injured limb was definitely longer than its fellow, as it was found that this gave the best end-results. It is most important to bear in mind that even when the main fragments of bone are separated by an interval of one or two inches, *the gap can be completely filled by new bone.*

Fourth. "Fixed" extension proved to be not so good as "continuous" extension. The traction can be employed either by fixing the foot and then lifting the end of the bed and letting the weight of the patient act as the extending agent, or else by applying weight traction. On the whole, the use of

the patient's own body weight was the method most in favor.

Fifth. Movements of the knee-joint were begun early, and slight flexion of the knee was always preferred to traction on the fully extended limb.

The early experience of the war had shown us that unless special precautions were taken, a permanently partially stiff knee-joint was extremely common. This might be due to (a) mild sepsis, (b) fracture near the articulation, (c) loss of elasticity and scarring, and adhesion of muscles, tendons, and skin. Captain Watkin Williams devised a very simple metal apparatus which was attached to the main splint and enabled the knee to be freely moved or fixed at any angle of flexion. Colonel Besley, of the Chicago unit, gave great help by the calipers which he devised. These were fixed above the condyles of the femur and were especially valuable for cases of fracture of the lower third of the femur, for their use completely overcame the flexion so common in these cases, and they also enabled the knee-joint to be freely moved without disturbing the traction on the femur. Many surgeons employed "caliper extension" for all their cases. It should be noted that if calipers are employed the following precautions are necessary: (a) rigorous asepsis, (b) avoidance of the synovial membrane, (c) avoidance of the thin articular bone of the condyles by fixing the calipers on the denser bone at the level of the adductor tubercle, (d) the use of any simple method for preventing the too deep penetration of the bone by the points of the calipers.

Sixth. For fractures about the upper third and the neck, the patient was placed either upon the hammock-like swing cradles invented and described by Major Sinclair, or else upon the special segmented mattress designed by Major Pearson. This latter was adopted late in 1918 by the Army Medical Department for the treatment of all cases of fixture of the femur under treatment in England, and has been fully figured and described by Major Pearson in his book.[1]

Seventh. When union was sufficiently advanced it was the custom to get patients out of bed while maintaining the length of the limb by the application of "walking caliper splints" fixed to the heel of the boot. If these were employed, the use of the limb accelerated the formation of callus, but if they were not provided, many limbs yielded and became bowed in attempts to walk.

Eighth. The treatment of the wounds was on general principles, but in the year 1918 very great benefit resulted from early "delayed primary suture" or from "secondary suture." Cases so treated showed a more rapid union of the fracture and a great shortening of the period of pyrexia. They also were much less liable to late necrosis of fragments and to secondary abscess. The natural result was a decreased mortality in sutured cases as compared to those unsutured, and a great diminution in the amputation rate. In cases which could not be sutured, the period of suppuration was often shortened by the employment of Carrel's methods.

Ninth. The question of the removal of bone was not entirely settled when the war ended. There was no doubt of the advisability of removing badly smashed fragments which had been completely separated. But, while most surgeons did not advocate the removal of more than this some operators followed the advice of Leriche and practiced "subperiosteal removal" of many of the partially detached fragments also. There seems no doubt that, on the one hand, the removal of all fragments which might necrose hastens the healing of the wound, while, on the other hand, this removal delays the union of the fracture, and in the opinion of some very competent observers has been responsible for permanent non-union in not a few instances.

THE MORTALITY AND THE RESULTS OF FRACTURE OF THE FEMUR CAUSED BY GUNSHOT WOUNDS

In the year 1917 a *rapport* by Lieutenant Colonel Max Page was read at a meeting of the Inter-Allied Conference in Paris. This *rapport* was the sequel to an enquiry in England as to the results of fracture of the femur in 1914, 1915, and 1916, and it was evident that many of these were very unsatisfactory. A large percentage of the patients

[1] Fractured Femurs. Pearson and Drummond, 1917.

was suffering from one or more of the following conditions:

1. Shortening of the limb of more than 1 inch, and sometimes of 2 or 3 inches.
2. Union of the fragments in bad position.
3. Stiffness of the knee-joint.
4. Sinuses.

In a smaller number of cases there was stiffness of the hip-joint, necrosis of large fragments, or imperfect union. A large proportion of the patients walked very badly.

These results made it evident that the methods of surgical treatment and the conditions for the hospitalization of patients in 1914, 1915, and 1916 were not satisfactory, although before the enquiry by Lieutenant Colonel Page early in 1917, many improvements in splints had already been adopted in France.

The previous conditions and methods of treatment may be very briefly described.

In the year 1914–1915 it had been necessary to send all patients to England as early as possible. This was due to the fact that there was not, at the time, sufficient accommodation in France for the large numbers of the wounded, but there is no doubt that the journey was bad for the patients.

During the same period the splints most commonly employed, both in France and England, were long wooden splints of the type known in England as "Liston's." Towards the end of 1915 skeleton metal splints began to be used in France, and during the year 1916 the "Thomas" splint came into universal use at the casualty clearing stations. During this year also the "stretcher suspension bar," for use with the Thomas splint (so long as the patient remained on his stretcher), became a part of the regular equipment.

It was during the Battle of the Somme in 1916 that for the first time during heavy fighting, both the Thomas splint and the "stretcher suspension bar" were supplied to the field ambulances of the Fourth and Fifth Armies, and, at the end of that year and in the beginning of 1917, both these appliances were sent up to the regimental aid posts of all armies and were commonly applied as soon as the stretcher-bearers found the wounded men.

During the year 1917 the patients *at the bases* in France were generally treated by skeleton metal splints and extension, by the methods demonstrated to the Inter-Allied Conference by Major Sinclair, but it became evident that yet better results could be obtained, and this object was achieved in 1918 by—

1. Retaining patients in France as long as possible before the journey to England.
2. The creation of special hospitals with specially trained staffs of surgeons and nurses.

The bombing of the hospital bases in France in June, 1918, resulted further in the creation of special hospitals for fractured femurs in England also, under the guidance of Sir Robert Jones.

The effect of these various measures was that many lives and limbs were saved, and that the limbs saved have shown very much less permanent disability than formerly.

The *mortality at the front* in the early days of the War cannot be directly compared with the mortality at the front in the year 1918, because the conditions were totally different. In 1914–1915, whenever there was heavy fighting, practically all patients, however bad their condition, were at once sent to the base hospitals by ambulance trains, because the casualty clearing stations were far too few and too small to accommodate them; and very large numbers of patients merely passed through these units on their way to the train. Yet, even then, it was found that not less than 16 per cent of one thousand consecutive cases died at the front, and it was estimated that the total mortality in France was at least 40 per cent, exclusive of those who subsequently died in England, so that the death rate was altogether not less than 40 to 50 per cent.

These figures are, however, rather misleading, for all cases of fractured femur are included in them, and among these not less than 20 or 30 per cent had either such serious local complications as injury to the main vessels, extensive comminution into a joint, or widespread laceration and destruction of large masses of muscle, while many other patients had multiple wounds involving other limbs or the viscera of the thorax or abdomen. It is not always possible to differentiate

between all these conditions, and it must be understood that the figures used in this communication include all patients in whom the femur was fractured, whatever complications there might have been.

The total mortality in the year 1918 may be estimated from the following figures. It has been found impossible to ascertain accurately the exact number of all cases and the results in all casualty clearing stations, because of the difficulties encountered in the retreat of March and April, but sufficient records have been obtained to enable satisfactory conclusions to be drawn.

AT THE FRONT

Of 3,141 cases admitted into various clearing stations, 550 died; i.e., 17.5 per cent. Of these cases approximately 21 per cent were treated by amputation. The mortality of the amputated cases was about 33 per cent. These are included in the total 550 deaths recorded above.

It was estimated that in between 20 and 30 per cent of the total number of 3,141, there were multiple wounds or such other serious complications as have been alluded to above. The mortality was very much higher in this class than in the remaining 70 per cent.

AT THE BASE HOSPITALS

During the year 1918, there were treated in the General Hospitals at the bases in France, 5,025 patients. Of these 547, or 10.8 per cent, died. Of these 5,025 cases, 513 were treated by amputation, or 10.2 per cent. The mortality of the amputated cases was about 33 per cent. All these are included in the figure of 547 given above

Enquiry in England shows that the mortality in the special hospitals more recently created has been very low and has generally been about 1 or 2 per cent. This is due to the fact that, first, the majority of all the cases were kept in France in 1918 until union had occurred and the wounds had healed; second, even in times of stress the worst cases were always retained in the special hospitals in France.

Amputations in England have, for the same reasons, been few.

From a consideration of the above figures it may be concluded that during the year 1918 the *total mortality* of all cases of fracture of the femur at the front, at base hospitals in France, and in England, amounted to, approximately, 30 per cent.

It must, however, be again pointed out that a very large proportion of the deaths occurred in men who had other serious injuries, and there is no doubt that in not a few of these, death was not due to the fracture of the femur, but to wounds of the viscera or to the shock caused by multiple injuries. My own impression is that the mortality of uncomplicated fractures of the femur due to "gunshot" wounds, and treated throughout by the most modern methods is not more than 20 per cent, and this conclusion has been arrived at after a long experience of these cases both at the front and in the base hospitals, and after an examination of many statistics.

AMPUTATIONS

A very large number of the deaths followed amputation, and about 27 per cent of all the patients with fracture of the femur lost the limb either by primary or secondary amputation. It will also be noted that in one-third of all the amputations, the operation failed to save life.

At the front the most common cause for amputation was that the extent and severity of the injury rendered it impossible to save the limb. In other cases laceration of the main vessels was the cause. In many cases the operation was performed for gas gangrene.

Many lives were saved by the employment of blood transfusion and by the use of gas and oxygen as an anæsthetic.

At the base hospitals the presence of gas gangrene was almost as often the cause of amputation as at the front, but in a good many cases the development at a later stage of intractable sepsis called for the removal of the limb. It must, however, be remembered that in March and April, 1918, several hundred cases had to be sent to the base for operations which would ordinarily have been performed in the casualty clearing stations.

The following figures of one general hospital may be taken as examples. Out of 71 amputations, gas gangrene caused 24; acute sepsis,

29; dry gangrene, 3; secondary hæmorrhage, 9; osteomyelitis, etc., 6.

FINAL RESULTS

The final results obtained in the limbs that were saved show a very great improvement on those of the early part of the War. They may be briefly summarized as follows:

1. *Shortening.* The methods of treatment of 1918 guarantee that unless there has been very extensive loss of bone no shortening need occur. It has been shown that even when 1 or 2 inches of the femur have been destroyed, the gap can be filled by new bone, and that, consequently, there is no objection to maintaining the fractured ends in full extension.

It had formerly been the practice of some surgeons to allow the separated fragments to come together so as to promote union, but it is certain that this should not, in the future, be a regular practice.

Practical experience has also shown that it is more difficult to obtain a full-length limb in cases of simple fracture, such as occur commonly in civil practice, for the uninjured muscles offer far greater resistance than those in a limb wounded by shell or bullets, and more extension is, consequently, required. The amount of shortening following gunshot fractures is shown, by the following figures, to have steadily decreased in each year of the War.

For these we are indebted to Major Stout, N. Z. M. C., and they include every case of fractured femur in the New Zealand Corps.

NEW ZEALAND FIGURES

Year	Cases	Average Shortening in Inches
1916	54	1.345
1917	116	.957
1918	90	.25

TWO SPECIAL BRITISH GENERAL HOSPITALS IN FRANCE, 1918

Cases	Average Shortening in Inches
343	0.2
60	0.2

Of these 60, 36 had no shortening.

Major Pearson, S. A. M. C., has supplied the following figures:

A SPECIAL HOSPITAL IN ENGLAND, 1918

Cases	No Shortening	Average Shortening of the Remaining 29 Cases
68	39	0.5 inch

Other hospitals show similar results, and it will be seen that the majority of the patients recovered without any shortening and that in only about 5 per cent of all cases was there more than 1 inch of shortening. Thus, of the 90 New Zealand cases in 1918, only two had more than an inch of shortening, and both of these patients had lost a good deal of bone.

The records of the various special hospitals necessarily vary somewhat, but the figures quoted are sufficient to prove that the previous difficulties in obtaining limbs of good length after gunshot fractures of the femur have been completely overcome, and that equally good results should be generally obtained in civilian practice as well as in war.

2. *Malposition.* The commonest displacement is a falling back of the lower fragment. The difficulties of correcting malposition almost disappeared in France as soon as a full length limb could be secured. A small percentage of the fractures near the knee and the hip recovered with some displacement remaining, but at least 80 per cent of the whole of the cases recovered with good position.

In fractures of the shaft, good position can practically always be secured, but it is most important thoroughly to support the bone at the site of fracture so that the natural anterior curve of the femur is either very fully maintained or even slightly exaggerated.

3. *Stiffness of knee-joint.* Major Pearson reports that of 68 cases, the number with a range of knee flexion over 90° was 55; the number with a range of knee flexion 60° to 90°, was 10; and the number with a range of knee flexion 30° to 60°, was 3. None had less than 30° of movement at the knee.

Of the New Zealand 264 cases, Major Stout reports the average range of flexion of the knee over the whole series was 43°.

Many other hospitals show similar results, and it is evident that there has been a great diminution of those cases in which the knee is left permanently stiff. There is no doubt that if suitable precautions are taken during treatment stiff knees in cases of fracture in the shaft of the femur should be very few.

4. *Stiffness of hip-joint.* This has not been a frequent complication, and it should never occur except in cases where the fracture

involves either the neck of the bone or the trochanters.

5. *Stiffness of ankle-joint.* This can always be avoided if care is taken not to keep the foot cramped by bandages, and to allow and encourage daily movement at the joint.

6. *Sinuses and necrosis.* Sinuses are seldom met with in the absence of necrosis, and as it has been the custom recently to remove sequestra earlier than in former years, the total number of patients with sinuses has greatly diminished.

7. *Non-union.* This is decidedly rare, and did not occur in more than about 1 per cent of the cases retained in France.

8. *Nerve injuries.* These are much more common than was generally appreciated. Out of a total of 297 cases of fractured femurs observed by Major Stout, important nerve injuries were found in 12 per cent, i. e., in 36 patients. The injured nerves were: the sciatic in 13 cases; the internal popliteal in 3 cases; and the external popliteal in 20 cases.

POSTOPERATIVE TETANUS

By R. R. HUGGINS, M.D., F.A.C.S., Pittsburgh

IT is difficult to conceive a more horrible ending to what would seem a normal convalescence, than death from tetanus. Reports in literature of postoperative tetanus are few and the various theories advanced show that there is much doubt as to why this unusual complication should follow in the wake of what has been considered clean operative technique. That a considerable proportion of the cases reported have occurred after abdominal operations makes this subject worthy of some attention on the part of the gynecologist. The limited number of such cases also suggests the necessity for careful study and the report in detail when it occurs. The wide distribution of the tetanus bacillus and its frequent occurrence in contaminated wounds under certain circumstances lead to the conclusion that we have been fortunate in having so few cases in our surgical work. That it should occur so much more frequently in intra-abdominal and pelvic work than in surgical procedures elsewhere commands attention. Many theories have been advanced concerning the predisposing causes of postoperative tetanus.

Pizzini has made the statement that 5 per cent of all normal men carry tetanus bacilli or the spores in an active state in the intestinal canal. This percentage is increased in all individuals working as drivers, hostlers, dairymen, etc. He suggests and urges preventive measures in cases to be operated upon which consist in depriving the patient of all raw vegetables, fruit, etc., for several days before operation.

Rudolph Matas states that in 2 cases the patients ate uncooked vegetables freely 24 and 36 hours previous to operation. He further notes the danger of tetanus in operations around the rectum, genital and lower pelvic regions.

Insen reports a case operated upon for tubercular peritonitis. The symptoms of tetanus began on the sixth day, death following in 34 hours. Cultures from the wound were negative. He agrees with Matas that the origin is in the intestinal canal, and organisms gain entrance with uncooked vegetables. He agrees with Matas in the necessity for prophylaxis by free purgation 4 or 5 days previous to operation and withholding all uncooked vegetables and fruit for that length of time. He is of the opinion that the normal defenses in healthy individuals protect them even though the tetanus bacilli may be present in the intestinal tract in large numbers. This is perhaps the only way to account for the great number of patients, who survive operations performed in fæcal contaminated areas.

Gum reports 4 cases, one of which was doubtful. After careful examination and cultures from air, ligatures, dressings, and everything associated, he came to the conclusion that the infection was carried by water. Examination of the water was negative but the soil which the water received as drainage was positive for tetanus bacilli. Other hospitals with the same water supply, however, had no tetanus. Examination of the cistern of the hospital revealed fungoid bodies but it was negative for tetanus bacilli. After removal of the cistern no more cases developed.

Hirst reports a few cases postpartum in which infection seemed to follow douching, the water evidently being contaminated. Catgut has been looked upon with a great deal of suspicion, but there are few cases in fact where it has been definitely traced to catgut. In many of the cases reported all cultures from the wound, fluids and catgut were negative.

Murphy reports a case which occurred in a milkmaid and at first she was thought to be a carrier. Later it was discovered that a surgeon in Calcutta had 3 cases and that he had used the same brand of catgut and that it had been shipped the same day. Other surgeons used gut made at the same time without any untoward results.

C. Nicholle reports a case that occurred in a hospital in Tunis where inoculations of animals made from the catgut showed positive results, the animals dying of tetanus. He states that the catgut was sterilized by chemical means. This is perhaps the only case where the responsibility was definitely fixed on catgut.

Richardson reported 2 cases and collected 21 from the literature. In 14, bacteriological study was made and a bacillus resembling tetanus was cultivated from the catgut in 4, but no animal died of tetanus after inoculation of the cultures. He refers to a paper by D. J. Hamilton on looping ill or sickness which occurs among sheep in certain parts of England. This bacillus resembles tetanus but its inoculation in animals will not produce tetanus. He suggests that the disease we call tetanus is one of the sheep diseases.

As German catgut was used in all of the 21 cases reported except one, there can be little likelihood of this form of infection being present in any of this series.

Wickersham has pointed out that the packing house receives practically nothing but range sheep in America, and that tetanus is not only rare among sheep but is almost unknown in range sheep. It would seem that the methods employed at present by all reliable manufacturers should kill the tetanus bacillus beyond any doubt.

Behrend collected 24 cases, only 3 recovered. He concludes that catgut is probably excluded as a causative factor. The absence of any definite knowledge as to how this infection gains its entrance, the high mortality and the tragic death when it occurs, all suggest more careful study of this dangerous complication. That it occurs so seldom does not permit indifference as it may happen at the most unexpected time. The experience of the writer would lead to the conclusion that some individuals possess a certain predisposition to tetanus. That such a thing as an inherent tendency exists and increases the susceptibility to certain forms of infection is probably true.

The following case is presented as one of tetanus, although the clinical diagnosis which was made from typical symptoms was not proven bacteriologically:

Mrs. A. B., age 48, Hosp. No. 89,147. This patient was admitted to St. Francis Hospital for operation January 6, 1919. She gave the history of an atypical menstrual flow and a period of bleeding some months previous to admission. The body of the uterus contained a small fibroid. The cervix was extensively diseased as a result of laceration and infection with chronic inflammatory change. The patient was extremely nervous and apprehensive. She had been advised to have an operation several months before she finally consented. During all this time she worried and could not persuade herself that she could undergo the ordeal safely and seemed constantly on the alert and filled with the idea that something would surely happen. This continued even after the operation was over. On the seventh day she insisted that something would turn up, although at that time she was in the best of condition. After admission she was kept in bed for several days and every care given to a study of her general condition with the view of not operating if any contra-indication was found. At the end of that

time the patient was much more composed and more optimistic. No reason could be found why there was any unusual risk and the operation was done.

Operation, January 11, 1919. Ether anæsthesia. After amputating the cervix with cautery, a piece of iodoform gauze was placed in the vagina. *Laparotomy.* The abdomen was opened in the midline. The uterus was found as above described, freely movable with no pathological change in the adnexa. The tubes and ovaries together with the uterus were removed in the usual manner; the raw surfaces being covered over with a flap of the peritoneum. A single cigarette drain was placed in the cul-de-sac. The peritoneum was closed with catgut, the fascia with interrupted sutures of catgut, fascia and skin with interrupted sutures of figure-of-eight silkworm-gut. The patient did not take her anæsthetic very well and the abdominal muscles were quite rigid throughout the operation. She left the table in good condition.

On section of the uterus, a small fibroid about the size of an almond, composed principally of connective tissue, was found located in the right side of the uterus between the layers of the broad ligaments; a number of small fibroids about the size of peas were scattered throughout the uterus. The entire musculature of the uterus was thickened and in certain places cut like scar tissue. There were several small areas just beneath the mucous membrane which were extremely hard.

Examination of the gall bladder revealed the presence of two gall stones which were not removed. The appendix was normal and was not removed.

Postoperative notes. January 22, 1919. Aside from some vomiting and considerable distention for the first 48 hours, the patient made an uneventful recovery. The patient's condition continued to be very good until January 19, 1919. During the day, she had some little stiffness of the masseter muscles but did not mention it to anyone; that night the stiffness became pronounced and the patient was unable to open her mouth, although the condition was not alarming. She said it was not at all strange to her as she had had this same condition twice before when she was extremely nervous and exhausted from overwork; in her opinion it seemed to be due to a disturbed state of her nervous system. She was seen by the writer the following morning. At that time there were no other symptoms present but the stiffness of the muscles of the jaw and inability to open the mouth, although she was able to take liquids without any particular discomfort. There was no rigidity of the muscles about the base of the skull or neck nor was rigidity present in any other part of the body. On account of the history given by the patient, we were somewhat puzzled at this time and unable to come to a definite conclusion as to the presence of a true tetanus. With the patient insisting that it was the same as had occurred before, we tried to hope that her observations were correct. Her condition remained the same until the following day when more definite symptoms seemed to occur. There was greater inconvenience in attempts to swallow, and the muscles of the abdomen seemed to be more rigid; the muscles of the jaw were more fixed and swallowing became difficult. She was given 5,000 units of antitetanic serum that evening. During the night she had two convulsions which lasted about 15 minutes. The following morning she received 20,000 units in the spinal canal, 5,000 units into the blood stream, and 5,000 units subcutaneously. Her temperature, up until this time, rose gradually until it reached 101°F. After the administration of the serum it rapidly rose to 105.5°F. per rectum. The pulse which had been fairly good increased in rapidity. There was no improvement in the symptoms during the day, and while she was able to open her mouth fairly well and there was also considerable relaxation of the muscles in general she lapsed into a state of unconsciousness and died at 7:15 p. m.

The interesting points in the discussion of this case were: First, the extreme nervousness of the patient. She was very apprehensive about the outlook and had postponed the operation for many months on this account, and from day to day even while she was making a perfectly normal convalescence, she seemed frightened and worried for fear something might turn up. Second, there was no apparent evidence of any local infection; the wound healed *per primam.* Her general condition and temperature suggested a normal convalescence to the time of the development of the above symptoms.

Smears and cultures were made from the abdominal wound which had healed without any evidence of infection. Cultures were also made from the vagina. No growth could be obtained which in any way resembled the tetanus bacillus. This was true also of the catgut used at operation. This is the first case of the kind in the history of the hospital and the absence of positive cultures from any part of the operative field leads to some confusion. A study of the spinal fluid was also negative.

A case such as described suggests the possibility of false tetanus under certain circumstances. The history given of two previous mild attacks lasting for several hours suggests the idea that the symptoms were due either to nervousness or that the woman had been a tetanus carrier and that the previous attacks had been a mild form of tetanus.

CONCLUSIONS

The study of the histories and comments on the various etiological factors as advanced by the men who have written on this subject suggests the following conclusions:

1. That tetanus is a complication which may follow any operative procedure but is more likely to follow abdominal or rectal operations.

2. More thought should be given to the possibility of its occurrence and, with this in mind, all green vegetables should be withheld for several days before operation.

3. There is danger in all operations around the rectum, genital, and lower pelvic regions.

4. It is significant that the Surgeon General of the U. S. A. ordered a prophylactic dose of tetanic serum given before all rectal operations during the late war. It is probable that this may become routine under certain circumstances.

UNUNITED FRACTURES OF THE HIP[1]

By M. S. HENDERSON, M.D., F.A.C.S., Rochester, Minnesota
Chief of Section on Orthopedic Surgery, Mayo Clinic

FRACTURES of the neck of the femur, commonly called fractures of the hip, occurring as they often do in the elderly person, present surgical conditions demanding the greatest care both in diagnosis and treatment. While this is true of all recent fractures of the hip, it is doubly true with regard to the treatment in the unfortunate group of cases in which bony union has failed. It is to the patients in this latter group that our attention is directed in this paper. A review was made of 120 cases of fractures of the surgical neck of the femur in which bony union had failed. While in a few instances fibrous union had become sufficiently firm so that restricted activity was possible without the aid of crutch or cane, in not a single instance, to our knowledge, except following operation, had bony union occurred.

It was our endeavor to determine if possible the reason for the non-union, whether operative procedures were justifiable, and, if so, what type of case was the most suitable for surgery. Ordinary manipulative procedures, such as Whitman's abduction method or Cotton's impaction method as applied to recent fractures, were not considered. By the term surgical procedure is meant the opening of the joint and the exposure of fragments, with such measures as seem best to promote union. It has been suggested by Brackett to place the tip of the trochanter, denuded, against the denuded head and thus attain bony union, but with this I have had no experience.

There were 68 males and 52 females in the series. Twenty-six were operated upon, and 94 were dismissed, nothing having been attempted to relieve the condition. Five patients were between 20 and 30 years; 20 were between 30 and 40; 20 were between 40 and 50; 46 were between 50 and 60; 24 between 60 and 70; 4 between 70 and 80; and one between 80 and 90.

After carefully reviewing the case records of these patients, the outstanding points established were that the non-union in the majority resulted from an incorrect diagnosis at the time of the accident, and that in the minority, even when the proper diagnosis had been made, no treatment had been carried out, often, it is true, for some justifiable reason. In a certain few the measures used had been rather in the form of a surgical ritual and were not in any sense of the word adequate. It was astonishing to ascertain how often elderly persons, who after a severe fall were disabled on account of intense pain in the hip, were told without being carefully examined that they were suffering from a sprain, the fracture not being diagnosed until months

[1] Presented before the Section on Orthopedic Surgery at the Seventieth Annual Session of the American Medical Association, Atlantic City, June 13, 1919.

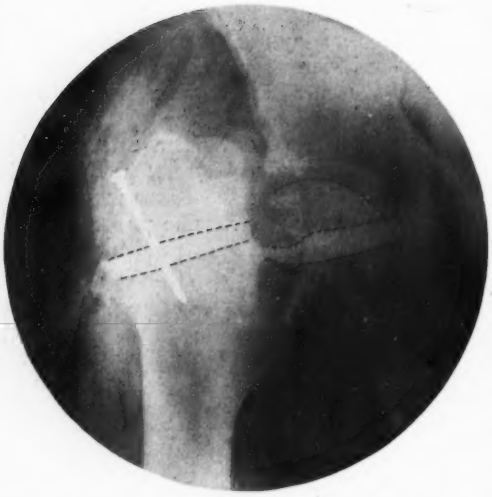


Fig. 1. Fracture of bone peg (tibia) probably due to fact that the bone peg was driven in so far that it engaged the acetalulum.

later, usually by another consultant. Another somewhat common story was that the physician who was called in, carefully measured the legs and finding no shortening or eliciting no crepitus, diagnosed a sprain without resorting to radiography. Weeks or months later, a consultation necessitated by continued disability revealed shortening of the affected leg, crepitus on manipulation, and a roentgengraph established the diagnosis of fracture. The probable explanation of this is that what was originally a more or less weakly impacted fracture, broke down through inadequate fixation of the limb. In none of the cases in this series was there a history of really proper treatment for the fracture. Good treatment had been instituted in a few instances but for some reason it was not prolonged enough. The patient may have been unruly, the supervision too weak, or complications, such as impending pneumonia, may have necessitated a discontinuance of treatment.

The fact that of the entire series of 120 patients, 94 were, for various reasons, denied the benefits of surgery, clearly shows that ununited fractures of the hip are not popular surgical risks. The mortality rate in the group of 26 patients was nil and in none of the cases did symptoms that were regarded as serious develop after operation. It is very evident that we must look farther to explain the low operative percentage. From a technical point of view, the operation is formidable. The incision must be large enough to permit of as free an approach to the hip-joint as possible, and care is required to prevent contamination during the manipulations necessary for exposure of the fragments. If an autogenous bone graft is to be used, the procedure is further complicated by a second wound and its care. Many of the patients are old, and have a low expectancy. The length of time necessary to complete the treatment and convalescence is comparatively great, and the general health in the elderly is often such that it does not seem justifiable to subject them to the risk of the operation and the confinement. The reparative properties of bone in persons of more than 45 or 50 years is not so great as in younger persons. The social status of the patients may be such that they cannot afford to pay even their living expenses while under care. Many patients present themselves years after the accident when the neck of the femur is completely absorbed. In cases otherwise suitable for operation, total absorption of the neck of the femur occurs, and it has been learned from this study that so far as any of the procedures herein considered are concerned, operation should not be done in this group. The fact that in our experience bony union is difficult to secure by any means at present known, considered with the aforesaid difficulties, is sufficient to make us very cautious with regard to prognosis. In some instances, all things considered, surgery is advisable, but, knowing that the results are uncertain, one does not feel justified in strongly urging the patient to submit to the operation.

It is unfair to take the percentage of cures that resulted in the 26 patients operated upon as a standard. Not a few of this group who we now know were not the best subjects for surgery were subjected to operation. Conclusions will, therefore, be drawn rather from the clinical experience gained than from any of the tabulated statistics. Twenty males

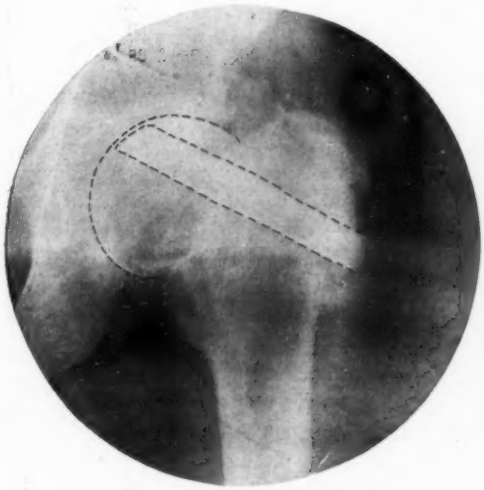


Fig. 2. Bone peg (fibula) properly placed.

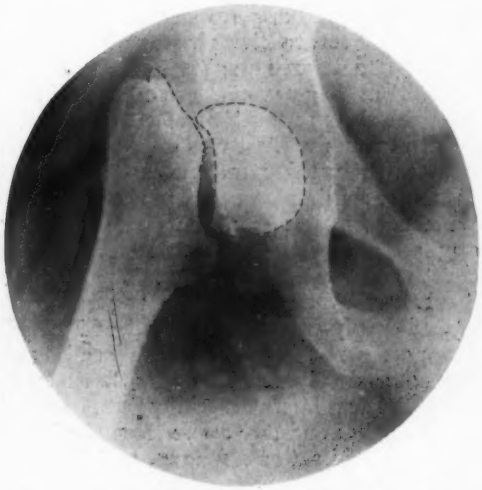


Fig. 3. Total absorption of the neck of the fibula in a female aged 25, 6 months after accident.

and 6 females were operated upon. Two were between 20 and 30; 6 between 30 and 40; 7 between 40 and 50, and 11 between 50 and 60. The duration of the non-union varied from 3 months to 3 years, an average of 13 months. Nails or screws were used in 8 cases, and bone in 18. There were, as I have stated, no deaths, and infection, which fortunately was not serious, developed in but 2. The operative field is rather difficult to keep clean in these cases, but a fracture table, such as the Hawley table, makes the entire procedure easier. Plenty of assistance must be available, and the best of technique and care must be taken to provide proper postoperative fixation. It has been our experience that a plaster-of-Paris cast affords the best means of maintaining the proper position. There is some controversy whether the bone graft or metal pegs should be used. Both are foreign bodies but the bone graft is absorbed. Consecutive roentgenographs of given cases show that the bone graft is gradually absorbed and is replaced by bone normal to the neck of the femur. Some of our patients treated with metal nails and screws have them in place years later with no inconvenience. We have used nails and screws, autogenous bone grafts, and beef bone screws. The last named are not best suited for the type of case under discussion but are most convenient in operating upon recent fractures of the hip.

Eight patients were operated upon with metal as a fixative with only one known good result, 3 with beef bone screws, and 15 with autogenous bone grafts. Various methods were employed with the bone graft. First the peg obtained from the tibia was tried; later packing the space between the head and the neck with bone was tried by placing therein two or three short grafts. It was hoped thus to re-establish a portion of the neck, but both of these methods have been abandoned for the use of the fibula, as advised by Davison. The curved U-shaped incision is used. The tip of the trochanter is removed, the method popularized by Murphy, as this has been found to give the best approach to the joint, and at the same time to give opportunity for inspection. In placing the graft from the fibula, care must be taken that the tunnel through the trochanter and the hole in the head are made the proper size so that the fit is snug, but not too tight, and that the angle at which the graft is placed is at least the normal angle of the neck to the shaft of the femur. Fixation

in a plaster-of-Paris spica cast, extending from the foot to the chest with the hip held in abduction, is maintained for at least 3 months. A great deal of comfort will be afforded the patient if the cast is not extended up on the chest wall on the side of the affected limb; this is not necessary for fixation since the limb is already in abduction.

It is not so easy as might be supposed properly to place a bone peg in a fractured hip. Care must be taken that the channel for it in the trochanter is correct. The peg must be placed deeply enough in the head, which is often poorly nourished, to get a good hold, but not so deeply that it engages the acetabulum, for in such cases a fixed point is formed on the pelvis and any appreciable motion of the thigh will act as a fulcrum and throw so much strain on the graft that it will break (Fig. 1). If the peg is properly placed, the head travels quite easily with the graft which readily stands the strain until sufficient new bone has formed to make bony union complete (Fig. 2).

The end-results of the operation in 7 of the 26 patients are not known; 10 operations were successful; 8 are known to be failures, and 1 patient is still under observation, but the result promises to be good. Thus there are 38 per cent good results; namely, bony union and good function. Of the entire series of 120 patients coming for relief, only 10 (8.3 per cent) were improved.

CONCLUSIONS

1. The most common cause of non-union is that the fracture is not recognized at the time of the accident. The disastrous result, therefore, is the result of no treatment. In cases in which the diagnosis is correctly made the treatment is often faulty and weak. An impacted fracture must be kept impacted until united.

2. As a group taken at large, ununited fractures of the hip offer a comparatively small percentage suitable for surgery; 26 (21.6 per cent) of the 120 patients were operated upon. In 10 of the cases operated upon (38 per cent) the operations were successful, giving, however, for the entire group of 120 cases only 8.3 per cent successfully treated.

3. Advanced age, poor general health, etc., are contra-indications to operation, but the chief contra-indication is absorption of the femoral neck. A person of 25 years may, in 5 months after the accident, show so much absorption of the neck of the femur (Fig. 3) that none of the measures herein considered offer any hope.

4. Any means, in suitable cases, that will freshen the fractured surfaces and maintain them in apposition is sufficient, but autogenous bone pegs are the most ideal.

5. From our experience, the fibula seems to be the best piece of bone to be used; it is easily obtained, and is never missed by the patient if it is removed anywhere four inches above the external malleolus.

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OPERATION FOR ADVANCED CARCINOMA OF THE TONGUE OR FLOOR OF THE MOUTH

By VILRAY PAPIN BLAIR, A.M., M.D., F.A.C.S., St. Louis

CLINICAL observation has led me to believe that, in spite of their high mortality, the majority of carcinomata of the mucosa of the mouth and upper air passages are for some time after their appearance not very malignant, and the present high mortality rate is due chiefly to late or inefficient operation, or both. In spite of the reasonable hope that the time is not far distant when early recognition will render the simpler operations efficient for all but the more malignant growths, at present most of the cases that we are called to treat are so far advanced as to require the more radical operations and many are not properly operable by any of the classic procedures. It was the cases of cancer of the tongue and floor of the mouth coming under the latter classification that led to a plan of operation that in its thoroughness may be compared to the "radical" operation for cancer of the breast. Unlike the latter, I do not believe it to be recommended for all cases of cancer of the tongue. Butlin's (1) analysis of his own results would lead one to believe that, with subsequent operation on the lymphatics, the Whitehead operation is suitable for many if not most cases. On the other hand, Lenthal Cheatle (2) concluded from his histological studies that extensive involvement of the associated muscles was the rule in the cases he examined, and therefore that the intrinsic and geniohyoglossus muscles should be removed in all cases.

It is my present belief that the operation to be described is properly applicable to the more advanced cases especially those that also involve the jaw, the floor of the mouth or the base of the tongue, or those with palpable involvement of the submaxillary nodes, and to early cases where, after removal by a less radical procedure, examination reveals a high grade malignancy. I believe that it has a lower death rate than any of the operations that involve cutting through the jaw bone. It is easily and quickly done and gives speech results that compare favorably with partial removals, but, after total removal of the tongue, chewing is impossible and deglutition is very much impaired. It consists in the block removal of the tongue, the structures in the floor of the mouth, all muscles above the body of the hyoid bone and stylohyoid muscles, the submaxillary and submental lymph nodes and as much of the faucial pillars and pharynx as desired; together with thorough cauterization of the mandible wherever the ulcer approaches or involves it.

The operation is performed as follows: Forced fluids are given for twenty-four hours before operation, and a low *bloodless* tracheotomy is done, preferably under a local anæsthetic; if a general anæsthetic is given before the tracheal tube is inserted, septic material may be aspirated. I believe there are very certain advantages in having the

Fig. 1. Line of incisions from behind the angle of the jaw on one side to a corresponding point on the other crossing the mid line at the lower border of the body of the hyoid bone.

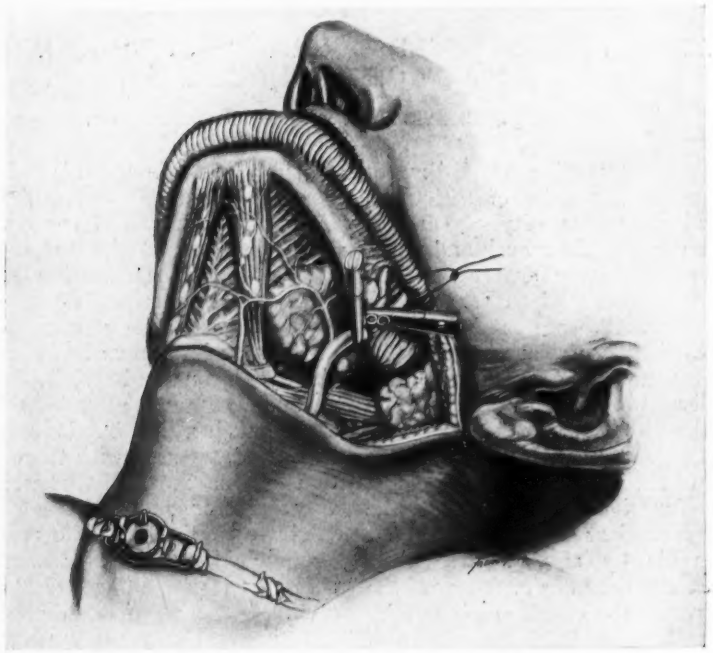

Fig. 2. Shows the skin platysma flap retracted upward and the facial artery and vein doubly caught and cut as they cross the lower jaw and ready to tie. In this figure and also in Figure 3, in order to identify them more easily, the muscles are shown stripped of their deep cervical fascia, but at operation they would be very much hidden by this fascia and usually by a deposit of fat.

tracheotomy precede the main operation by a day or more. The tracheal tube should be large—at least a No. 6, and long enough to reach well into the trachea; in a low tracheotomy the ordinary tube is not long enough except for very thin individuals. No attempt is made to clean up the inside of the mouth before operation; a person in ordinary health has some immunity to the organisms he habitually carries but trauma may destroy this immunity.

The incision shown in Figure 1 skirts the lower border of the hyoid bone and goes just through the platysma muscle. With two sharp, rake retractors, the skin and platysma above the incision are avulsed forcefully upward from the deep cervical fascia, cutting the more resistant strands of tissue and the blood vessels, until the lower border of the mandible and the facial vessels crossing it are well exposed. At the border of the jaw the facial artery and vein are caught with two forceps, cut, and tied above the normal site of the buccal node that lies on the vessels (Fig. 2). At the level of the skin incision the facial vein is divided between ligatures and after freeing the submaxillary salivary gland at its lower border it is drawn forcefully upward until the facial artery is well exposed emerging from beneath the upper border of the digastric muscle to enter the gland. As far as possible from its origin, an inch from the digastric if practicable, the artery is caught between two forceps, cut, and ligated. Then a search is made for any branches of the facial arising within one-half inch proximal to the ligature. There are usually two, a very small and a larger one, and these should be ligated. This assures a long clot in the cut stump of the facial artery. Just below the

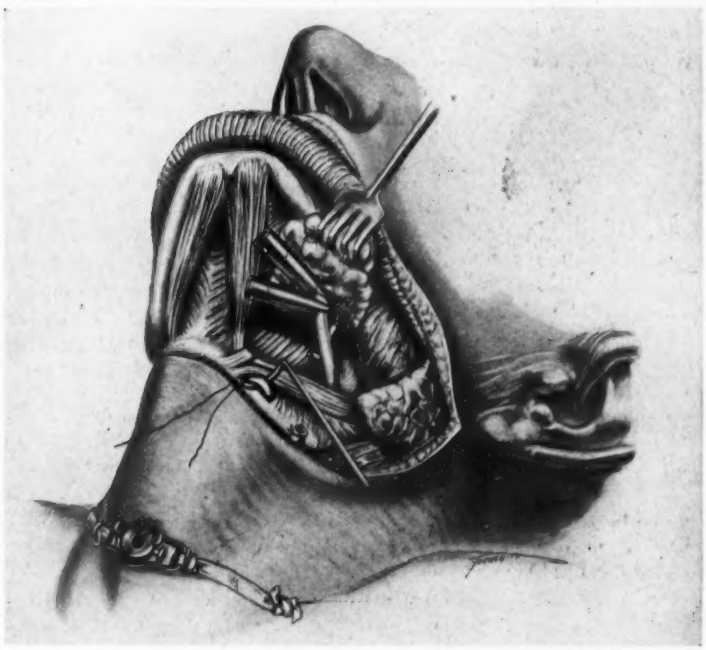

Fig. 3. Shows the submaxillary gland of the left side drawn forcefully upward and the facial artery caught and ready to be cut and ligated as it enters the gland. The lingual artery is shown drawn out through a separation between the fibers of the hyoglossus muscle ready for ligation.

outer part of the digastric tendon, the fibers of the hyoglossus muscle are separated by thrusting in the points of dissecting scissors, and the lingual artery is grasped and ligated—Kocher's ligation — (Fig. 3).

The blood supply being now controlled, the excision is made with a cutting cautery starting at the symphysis and cutting through the digastrics, geniohyoids, geniohyoglossi and myohyoid muscles, stripping the periosteum and mucoperiosteum from the inner surface of the jaw. If the ulcer approaches the bone, prolonged cooking with a heavy cautery is done. The tongue is next drawn out through this opening which brings the pillars and the pharynx into plain view, the excision here being guided by the position and extent of the growth. Finally the base of the tongue is cut across right at the hyoid bone and I believe it is well also at this time to remove the lower part of each parotid gland on account of the closely associated lymph nodes.

The lower border of each digastric muscle is sutured to the anterior border of the sternomastoid with fine tannated gut, and the ligated facial artery stumps are left standing out free in the pharynx. This plan of treating the facial artery, in my opinion, is safer than burying it in tissue that may become septic. I have had several opportunities to observe the subsequent course which is, if the efferent branches have been ligated, that they become occluded by a clot and then shrink up and disappear. If subsequent bleeding should occur as it did in one of my cases, from an unligated efferent branch which tore loose in a coughing spell, the sutures can be removed and the bleeder is in plain sight. If moderately enlarged cervical nodes tend to protrude from between the sternomastoid and the digastric muscles, they are

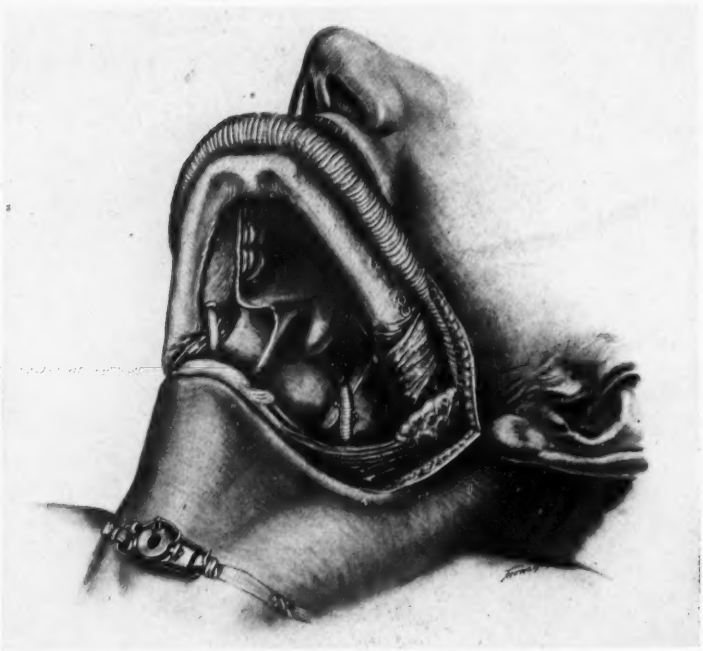

Fig. 4. Shows the completed excision and the wound ready to close. Note that in this case the posterior pillars of the pharynx are left intact while the anterior pillars and the tonsils have been removed leaving the lower part of the internal pterygoid muscles exposed. The illustration also shows the lower part of the parotid gland removed, the facial artery standing up free in the pharynx and the posterior belly of the digastric muscle sutured to the sternomastoid to wall off the carotid triangle from the pharynx. If, before suturing these two muscles, the space between them has any depth, it should be drained by a separate stab wound through the skin.

not ordinarily removed, but the sternomastoid is somewhat freed so that it can be sutured over these to the digastric. If one invades the carotid triangle at this time, it is apt to complicate and unduly prolong the operation. Before closing the external wound a large catheter is passed through one nostril into the pharynx and fastened by a strip of adhesive plaster one-half inch wide, to the upper lip. After the excision, the larynx drops very low and unless this catheter is guided by a finger in the pharynx, it is apt to enter the glottis. The external wound is closed without drainage by silkworm-gut mattress sutures that insure deep approximation of the skin and platysma. The cut or burned surface of the parotid should not be included in the approximation, as the secretion causes induration and suppuration. The floor of the mouth and all other raw surfaces are covered with a pack of broad strips of iodoform gauze into which balsam of Peru is thoroughly incorporated, this pack to be left in place several days and then renewed as necessary until the sloughs separate. This will entirely control all odors from the decomposing sloughs.

Postoperative treatment. The patient is put to bed in a semi-sitting posture. Proctoclysis is instituted and fluids given through the nasal tube as soon as tolerated. Frequent inhalations of benzoin steam and small doses of iodides to loosen secretions are given when necessary and morphine as needed.

The tracheal tube is retained until danger of œdema or of respiratory interference from

the packs is passed; before removing the tube a cork is placed in it for 24 hours. Usually after 10 days the patient can make very effective efforts to swallow but only water should be given until one can be sure that no fluid enters the glottis, at which time the nasal feeding tube can be removed.

After 6 weeks a very intelligible speech is usually developed but the rapidity of the return of all these functions depends largely on the intelligence and industry of the patient. A physician from whom I removed the whole tongue and the muscles of the floor 5 years ago has been practising his profession all this time and his speech is so perfect that few people know he has had an operation in his mouth, though he told me his vocabulary has been reduced about 30 per cent.

This operation is to be followed later by the radical dissection of the lymph-bearing areas of both sides of the neck; a plan for doing this that fits in with the preceding operation will be presented in the future.

The operation presented can be modified in a number of ways and in its present form is the outcome of several plans having in common the suprahyoid approach and the removal of the tumor, the muscles of the floor, and the upper lymphatics in one block.

The first operations were done in 1913 for cases of ulcer of the floor, tongue and jaw and at this time the body of the mandible was included in the excision; now I believe that thorough cauterization of the invaded bone with a soldering iron or Percy cautery is as curative, and besides the better functional results, is a safer operation. If the cauterization of bone is too prolonged the latter may be killed through the full thickness and no regeneration occur. I have had this experience. In one instance the hyoid bone and epiglottis were included in the excision. In this case persistent œdema of the glottis greatly retarded recovery of function.

This operation might be done on one side only but I have not seen a case in which I thought it indicated that I did not believe the most radical removal was necessary.

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ACUTE EMPYEMA OF THORAX TREATED BY MINOR INTERCOSTAL THORACOTOMY

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An analysis of the cases of empyema treated at Mount Sinai Hospital during a period of ten years (1903–1913) was reported by Wilensky. Thoracotomy with rib resection was the operation of choice, drainage being established with two large rubber tubes, and the dressings being changed as often as the amount of discharge required. Of 258 cases of acute empyema treated thus, 59 died, a mortality of 23 per cent. Fifty cases were not cured by the primary operation, i.e., 20 per cent of all cases. Cures resulting from the primary operation amounted to 57 per cent of cases.

The chief source of dissatisfaction was the fact that those not cured by the operation were destined to a long period of ill health, to a long period of after-care in the dispensary, to repeated secondary operations frequently increasing in extent, severity and risk, and often terminating in one or another type of deforming thoracoplastic collapsing operation. Not a few succumbed to these procedures, and of those who subsequently left the hospital "well," we did not know how many were restored to former health and usefulness. Other sources of dissatisfaction were the following: The patients were often very uncomfortable as a result of the necessarily bulky dressings, the maceration and infection of the skin due to the discharges, the free communication of the pleural cavity with the outer air (in spite of attempted occlusive dressings), and the necessarily frequent changes of dressings and tubes. The empyema cases were regarded as a nuisance in the wards. The dressings, saturated with pus, produced foul odors which disgusted the patients, and caused anorexia, an exceedingly unfavorable symptom in these cases. The quantity of dressings used was a source of considerable expense to the hospital.

To obtain better final results in empyema of the thorax, to prevent persistent sinuses and cavities, and fixation of the lung in an unfavorable position, Dr. Lilienthal proposed the operation of major intercostal thoracotomy. The principle was that of a free, wide exploration and thorough mobilization of the lung. When the condition of the patient rendered the operation inadvisable as a primary procedure, a small intercostal incision was made and a single tube inserted. In a few days or a few weeks the larger procedure was undertaken, if deemed necessary.

When rib resection for thoracotomy was in vogue, intercostal incision was reserved for those empyema patients who were desperately ill, in whom it was advisable merely to relieve the intrathoracic pressure symptoms. The mortality was consequently very high, Wilensky's statistics showing 11 deaths in 21 cases. It was noted, however, that those who survived gave practically no trouble in their after-treatment. They healed kindly and rapidly. When the operation of major intercostal thoracotomy was first introduced, simple intercostal drainage was likewise an operation of necessity and a preliminary to the radical procedure. In the series of 23 cases reported by Lilienthal in 1915, only 3 were done in two stages, while of the larger series reported in 1917, one-third was done in two stages. At the same time 38 cases were treated by minor thoracotomy alone with the low mortality of 18.4 per cent and excellent final results. Gradually more and more cases of acute empyema were treated by minor thoracotomy and the operation came to be one of choice instead of that of necessity.

The present report deals with 71 cases of acute empyema treated by intercostal incision during a period of 15 months (January 1, 1918, to April 1, 1919) on the surgical services of Drs. Lilienthal, Berg, and Beer.[1]

[1] For a period of three months when a considerable number of empyemas occurred after the recent influenza epidemic, Dr. A. A. Berg, who was then in charge of the three services, permitted me to supervise all the empyema cases on his service.

It was the practice in all cases except those of immediate urgency to have a roentgen examination of the chest before operation, and preferably before exploratory aspiration. It was deemed inadvisable to perform aspiration before the X-ray examination as this occasionally admitted air into the pleural cavity and confused the picture. Many of the patients had been aspirated before coming into the hospital, and two of these had submuscular abscesses as a result of leakage along the needle track, i.e., induced empyema necessitatis.

The X-ray examination with the patient in an upright position in cases of intrathoracic suppuration is often of great value, and should precede aspiration, if feasible. It informs us of the condition of the apparently uninvolved side, revealing at times an undetected pneumonia or a small effusion. It may show the presence of air as well as fluid in the chest, indicating communication with the bronchial system, due to rupture of a suppurative focus in the lung into the pleural cavity. Cases of this type, with bronchial fistula, form a separate group both as to prognosis and treatment. The examination may show one or more distinctly encapsulated or sacculated collections of fluid, and these form a third group of cases as regards treatment. At times when the physical signs suggest fluid and even when exploratory aspiration has yielded a few cubic centimeters of exudate, the X-ray reveals pneumonia or perhaps lung abscess.[1]

In seven cases the fluid aspirated prior to operation was not macroscopically purulent, although examination showed pus cells and bacteria, and cultures yielded a growth. These were treated by preliminary Potain aspiration. The toxic and septic phenomena in these cases were believed due to the underlying concomitant pneumonia. Our past experience coinciding with that of the military surgeons during the pneumonia epidemics in the mobilization camps, induced us to allow the patient to overcome his pneumonic infection, meanwhile relieving the intrathoracic pressure effects by aspiration of the fluid, as often as necessary. These cases later developed frank purulent fluid, but by the time this occurred the general condition was greatly improved, the temperature much lower, or even normal, and the outlook more favorable for recovery after the drainage operation. Adhesions had formed, and acute pneumothorax was avoided. One of these patients died, the others made a smooth recovery after minor thoracotomy.

[1] If the clinical course plus the roentgen findings make the diagnosis of lung abscess reasonably certain, it is well to postpone aspiration, if this be deemed necessary, until just before the contemplated operation. Aspiration through the indurated lung tissue permits leakage along the needle track and may cause virulent empyema or phlegmon of the chest wall.

TECHNIQUE OF OPERATION

The patients being in the hospital, the operation was performed in the operating room, but the procedure is so simple and requires so few instruments that if necessary, the patient need not be moved from his bed. Of the 71 cases, 32 were done with local anæsthesia, 26 under ether, 5 under gas and oxygen, 2 under chloroform, 6 not recorded. Local anæsthesia was used for children as well as adults. It would seem desirable to avoid ether in all cases such as these in which the lungs are or have recently been the site of a pneumonia. In addition to the usual infiltration with 0.5 per cent novocaine along the line of incision, an effort was made by some operators to block the intercostal nerves by infiltrating at the borders of the ribs bounding the intercostal space at a point posterior to the line of incision. This was found to lessen considerably the pain of entering the pleura and the discomfort of introducing the drainage tube.

It was our aim to drain the chest at the lowest possible point. Aspiration was made in the posterior axillary line through the eighth space, at times the ninth space. In a few cases, pus was found in the axilla and drainage was performed there. The pus having been located at its dependent point, the needle was left *in situ* and marked the center of a 1.5 inch incision which was carried down to muscle layers. A grooved director was passed along the needle and the latter withdrawn. A dressing forceps was now passed along the groove and the pleural opening spread sufficiently to permit introduction of a tube of suitable diameter (1.0 to

1.5 centimeters), held in the grasp of a long artery forceps, and provided with a side hole about an inch from its end. The muscle fibers not being cut acted somewhat as a sphincter would, surrounded the tube closely, and made for an air-tight drainage. The tube was introduced so that the fenestra was just within the pleura, part of the pus was allowed to escape and then it was clamped. The superficial wound was lightly packed, the tube secured by a safety pin and adhesive strips to the skin, and a small dressing applied over the whole. The patient was then placed in the special bed for empyema cases designed by Dr. Roth.

In two cases, young infants, drainage was established by inserting, under local anæsthesia, a trocar and cannula, threading a tube through the cannula, and withdrawing the latter, leaving the tube in place.

POSTOPERATIVE TREATMENT

This was greatly facilitated by the employment, in children, of the empyema bed devised by Irving R. Roth and in use since August, 1917. The child lies on the affected side on a canvas spanned across the bed frame, the drainage tube passing through a window in the canvas to an air-tight pus-collecting bottle. The air is exhausted from the latter by means of a partial vacuum produced by gravity in a large irrigating bottle, from the bottom spout of which water is allowed to flow into a plain receiving bottle.

By means of this device the pus is collected in a bottle, no soiling of dressings, linens, etc., occurs, and the skin is entirely free of irritating discharges. The forces of gravity and negative pressure are applied to keep the chest empty of pus and to favor pulmonary expansion. The amount and character of the discharge are readily observed. The same method of drainage is applied to adults by allowing the thoracic drainage tube to pass to the pus bottle between the two sections of a transversely split mattress.

The drainage tube is changed and the wound dressed every three or four days. In cases in which there are large amounts of fibrin in the discharge the drainage tube and the dressing must be changed oftener.

The guides to the progress of the case consist in the following: first, the clinical course of the patient, in whom we note decrease of temperature, of pulse and respiratory rate, increase of appetite, improved sleep and comfort, a brighter, more cheerful aspect (in short a disappearance of the septic phenomena); second, decrease in amount and change in character of the discharge, a reduction to about 4 drams of serous fluid per day warranting discontinuing the apparatus; third, fluoroscopic and radiographic evidence of expansion of the lung and absence of retention or sacculation.

Just as the roentgen examination is of much diagnostic value in empyema, of no less aid is it in the after-care of the case. Unexplained retrogressions with febrile course may be clarified by X-ray findings of sacculation and retention, pneumonia in the same or opposite lung, or abscess of the lung previously hidden by the fluid in the chest. The persistence of purulent discharge may be explained by the X-ray picture of a pneumothorax of greater or lesser degree with fixation of the lung by a dense membrane. Here the fluoroscopic data are of value in prognosis and therapy. If such examination shows any expansion of the lung when the patient coughs or strains, a conservative course is indicated. In these cases persistence in drainage and efforts at disinfection may result in aseptic healing of the wound and a gradual obliteration of the dead space by pulmonary expansion together with some contraction of the thoracic walls.

If, however, the lung is found persistently fixed in an unfavorable position and incompletely expanded, we believe that operative interference is indicated, and our preference is for the procedure of major intercostal thoracotomy, which aims to mobilize the lung. Although disinfection of such cavities is attainable, and closure of the wound takes place (we agree with Moschcowitz in not employing secondary suture), dead spaces of this kind frequently become reinfected and open of their own accord or require secondary drainage. We distinguish, therefore, between

pneumothorax which tends to obliteration, and pneumothorax which repeated examination shows to be constant. We have not had sufficient evidence to corroborate the belief that Dakin's fluid will dissolve the limiting membrane and accomplish mobilization in the latter group of cases. Microscopic examination of such membranes in a few cases treated by major thoracotomy showed them to be organized connective-tissue structures and not fibrinopurulent exudates.

The use of Dakin's fluid was added to the method of drainage described by inserting a T-tube between the thoracic drain and the pus-collecting bottle. The reservoir for the antiseptic was connected to the side-arm of the T-tube and the fluid in varying amounts (25 to 100 cubic centimeters), allowed to enter the chest every two hours (in some cases every hour) by day, and twice during the night. The suction was suspended for 15 minutes by clamping the tube connecting the glass T with the pus bottle, and then resumed until the time for the next instillation of Dakin's fluid. Caution was observed in using the fluid, the first instillation being made slowly with a syringe containing 10 or 15 cubic centimeters. While we were usually aware of the presence of a pleuropulmonary fistula, at times our first definite knowledge had come when instillation of the fluid by the nurse produced violent cough, cyanosis and acute distress, the patient later stating that he tasted the chlorine and felt as though he were being strangled. The appearance of blood in the discharge, not ascribable to trauma of dressing, was considered an indication to stop the use of Dakin's fluid, as serious bleeding had been reported in some cases.

The solution kept the discharges thin and limpid and prevented clogging of the drain, which, nevertheless, was changed daily while disinfection was being practiced. At times when the suction apparatus was discontinued a single short Carrel tube was inserted in the sinus and the fluid instilled through this. A comparison of the results in cases treated with and without Dakin's fluid showed no more rapid healing in the former.

RESULTS OF USING DAKIN'S SOLUTION

Treated with Dakin's

Cases	23 (8 adults)
Hospital stay	43 days (18 to 91)
Suction drainage renewed	4 cases

Treated without Dakin's

Cases	28 (10 adults)
Hospital stay	39 days (16 to 74)
Suction drainage renewed	3 cases

I feel certain, however, that our organization, necessitating changing of nurses and of ward doctors at rather frequent intervals, did not lend itself to ideal application of disinfecting methods in all cases in which it was attempted.

When the amount and character of the discharge or the microscopic examination of the pus (absence of bacteria) indicated that the infection was controlled, and the roentgenographic studies indicated favorable physical conditions within the thorax, the apparatus was discontinued, a small tube inserted just to the pleural cavity and the patient encouraged to be up and about. In a few days the tube was removed and the wound allowed to heal. In eight cases it was necessary to renew the suction drainage for an additional period because of recurrence of infection and retention.

Certain adjuvants were found of value in treating these patients:

First, an effort was made to maintain the nutrition of the patient at a high level by extra feeding. Second, expansion of the lung was encouraged by having the patient use blowing bottles. Dr. Lilienthal had the children use toy balloons to the mouth piece of which a constricted rubber tube was attached, thereby enforcing increased respiratory efforts. Third, as far as facilities permitted, exposure to fresh air and sunshine was employed and in some very serious cases this seemed to be a determining factor in recovery of the patient.

Analysis of the data derivable from the 71 cases studied may be best presented as follows:

Causation. Reliance had to be placed mostly on the history of the case, as the patients had usually been treated at home for their preceding illnesses.

Scarlet fever..... 1[1]
Primary (?)..... 4
Pneumonia 66
(20 of which were postinfluenzal)

Sex
Males, 38; deaths, 8.
Females, 33; deaths, 5.

Side involved
Right, 39; deaths, 9.
Left, 31; deaths, 4.
Bilateral, 1; deaths, 0.

Bacteriology
Sterile, 5 (3 showed organisms in spreads); deaths, 0.
Streptococcus hæmolyticus, 20; deaths, 4.
Streptococcus anhæmolyticus, 2; deaths, 1.
Pneumococcus, 18 (I, 3; II, 4; III, 1; IV, 8); deaths, 3.
Staphylococcus aureus, 9; deaths, 3.
Staphylococcus aureus and pneumococcus, 1; deaths, 0.
Not reported, 16; deaths, 2.

Age and Results

Under 1 year.....	6	2	4	0
1 to 2 years.....	11	5	6	0
2 to 3 years.....	9	2	7	0
3 to 5 years.....	6	1	5	0
5 to 10 years.....	17	1	12	4
10 to 20 years.....	9	0	7	2
20 to 30 years.....	7	1	5	1
30 to 40 years.....	4	0	4	0
40 to 50 years.....	0	0	0	0
50 to 60 years.....	2	1	1	0
	71	13	51	7

Youngest, 14 weeks, cured.
Oldest, 60 years, died.

[1] This child, whose empyema followed scarlet fever, went through diphtheria and measles with his chest undrained.

RESULTS COMPARED TO SERIES TREATED BY RIB RESECTION

Intercostal incision:
Cases.....71
Deaths.....13, or 18 per cent
Cured.....51, or 72 per cent
Not cured..... 7, or 10 per cent

Rib resection:
Cases.....258
Deaths..... 50, or 23 per cent
Cured.....149, or 57 per cent
Not cured..... 50, or 20 per cent

It is true that the present series of cases amounts to only one-quarter of those treated by rib resection in former years, but cases treated by intercostal drainage in Lilienthal's report of 1917, showed a mortality of only 18 per cent also. We have, therefore, a decrease in mortality of 5 per cent, a decrease in cases requiring secondary operation of 10 per cent, and an increase of cures by the primary operation of 15 per cent. Aside from these advantages are those which cannot be expressed in figures, namely, the greater comfort of the patient, the cleanliness of the method, the improved morale of the patients on the ward, the saving in time, labor, and material in the after-care of the cases.

The procedure of minor intercostal thoracotomy surely eliminates one factor in the production of persistent sinuses after empyema, namely, infection of the resected rib. In 89 cases of chronic empyema analyzed by Wilensky, 6 were attributable to disease of the ribs, and in the series of acute empyemas osteomyelitis occurred 4 times. This incidence is relatively low. Petit, for example, reports 16 cases of persistent empyema sinus in 12 of which disease of the previously resected rib was present. Tuffier likewise notes the frequency of osseous infections following rib resection. It seems reasonable to believe that disease of the rib can delay healing not only by necessitating sequestration, but by reinfection of the empyema cavity as well from the focus in the chest wall.

In one case treated by minor thoracotomy pressure of the tube caused denudation of the periosteum of the ribs, but this covered over when the tube was removed, and healing took place.

Hospital stay. The 51 cases cured by intercostal drainage alone remained in the hospital from 16 to 91 days, the average being 41 days.

Of these cases 29 were completely healed when discharged, 19 cases required from one to four superficial dressings in the dispensary, 2 cases were dressed twice a week for 4 weeks, and 1 was dressed at another hospital dispensary for 3 months. This patient said that at no time was there much discharge, and at no time was a tube inserted, the reason for the tardy healing of the sinus not being apparent.

Mortality. Of the 13 patients who died, 11 were children. Two cases, desperately ill and intensely cyanotic, ceased within an hour after operation. Three cases had diffuse bronchopneumonia, 3 had pneumonia on the same side, and 2 on the opposite side. Otitis media was noted in 3 cases; furunculosis, impetigo, and purpura once each. One man of 60 was doing fairly well and out of bed, when he was stricken with hemiplegia and died.

COMPLICATIONS

	Deaths	Cured	Not Cured
Pneumonia			
Same side	3	5	0
Opposite side	2	1	0
Bronchopneumonia	3	0	1
Otitis media	3	4	1
Cerebral complications			
Hemiparesis	0	1	0
Hemiplegia	1	1	0
Skin lesions			
Furunculosis	1	1	0
Impetigo.....same case	1	0	0
Purpura (also had bronchopneumonia)	1	0	0
Subcutaneous abscesses	0	2	0
Measles	0	2	0
Diphtheria	0	5	0
Pregnancy	0	1	0
Eroded rib	0	1	0
Bronchial fistula	0	2	0
Persistent sinus	0	0	2
Persistent pneumothorax (also had pneumonia)	2	0	5

Cases not cured by primary operation. Five cases showed a persistent pneumothorax, 4 having been treated with Dakin's solution after the primary operation. Three of these were cured of this condition by major intercostal thoracotomy. One was cured by resection of large segments of two ribs, and mobilization of the lung through this wound. One case was discharged uncured, the patient refusing radical operation.

Two cases had persistent sinuses the cause of which was not clear from our records. One, a child, was not brought back for study, though the mother was directed to do so. The record of the other case was incomplete, but cure was apparently not effected.

Sacculated empyema. Strictly speaking all empyemas are encapsulated, for only in the earliest stage is the fluid free in the pleural cavity. It becomes walled off by adhesions as the purulent stage supervenes. Well-defined sacculations may occur either as the result of incomplete resolution of a general pleuritis or as the result of an originally localized pleuritis. Such sacculations occur most often in the axilla, frequently high up over the upper lobe. Next in frequency are collections of pus postero-internal to the lung, occupying the concavity formed by the vertebræ and the ribs mesial to their angles, but sometimes extending out to the posterior or midaxillary line. Other, more unusual sites are the anterior aspect of the lung, between the lung and the parietal pleura covering the structures of the middle and anterior mediastinum, between the base of the lung and the diaphragm, and between the lobes of the lung. True interlobar empyema is uncommon.

The treatment of these cases must vary with the individual conditions. Large encapsulated empyema, usually behind the lung, presents a clinical course similar to that of ordinary empyema and may be treated in the same way, namely, by minor intercostal thoracotomy at the most dependent point. Small solitary pleural abscess is insidious in its onset, symptomatology and clinical course. When diagnosticated, it has usually been in existence for some time, its limiting walls are dense and unyielding. It is best treated by resection of a portion of the rib corresponding to its most dependent point. Discission of the visceral pleura may be of assistance in hastening obliteration of the cavity. When two distinct pleural abscesses exist it is questionable whether each should be drained separately, or whether major thoracotomy should be resorted to, using suction apparatus to minimize soiling of the general pleural cavity, and mobilizing the lung so as to accomplish rapid obliteration of the cavities. When it is possible by roentgen examination and exploratory aspirations (different types of fluid being withdrawn) to determine that the empyema is multilocular, a wide exposure is desirable, permitting emptying of all the locules, breaking down of the adhesions separating them, and mobilization of the lung.

The series of cases discussed in this paper include only two sacculated empyemas, treated by minor thoracotomy.

Bronchial fistula. The presence of a communication of the bronchial system with the pleural cavity indicates that a suppurative focus in the lung, a smaller or larger abscess, has caused the infection of the pleural cavity. This rupture of the focus produces a pyopneumothorax. These patients are usually very ill, dyspnœic, cyanotic, anxious, with rapid pulse and marked febrile course. They sit up in bed and cannot be persuaded to lie down. Operation should be done as soon as possible

with local anæsthesia, the patient sitting up. To turn the patient on his healthy side is to invite a gush of pus from the trachea, and with general anæsthesia, an almost certain aspiration pneumonia on the opposite side. Although two cases of bronchial fistula were treated with good result by minor thoracotomy, drainage by resection of part of a rib with its periosteum is preferable. A wide thoracic opening is of advantage because adequate drainage must be maintained until the fistula heals. It is of no disadvantage because the lung cannot expand until the fistula has closed, and most fistulæ close spontaneously. Intercostal incision does not serve well because the thorax, in these cases, undergoes rapid contraction, the ribs crowd together, and drainage is interfered with.

Not infrequently a small fistula is present which is not discovered until after operation. Failure of the lung to expand properly should lead one to suspect this. A tightly fitting tube leading from the empyema cavity into a dish of sterile water will help in deciding the point. If a fistula is present forceful expiration will cause a stream of air bubbles to issue from the tube. If there is no fistula, some bubbles will come through until the next inspiration, when they cease to appear and water is drawn up through the tube into the chest. At times the injection of bismuth paste will be followed by expectoration of some of the injected substance. The use of Dakin's solution not infrequently reveals the presence of a fistula, patients with this condition tasting the solution (i.e., the chlorine gas liberated) when small amounts are used, and presenting at times rather alarming symptoms when large amounts are used.

CONCLUSION

The proper treatment of empyema requires close co-operation of the internist, the surgeon, and the roentgenologist. For purposes of prognosis and treatment empyemas may be best divided into ordinary empyema, pyopneumothorax, and sacculated empyema. Cases due to specific infections, such as tuberculosis and actinomycosis, should not be grouped with those caused by the ordinary pyogenic organisms.

We may fairly conclude from the cases analyzed that simple intercostal thoracotomy with the method of drainage described has yielded results superior to those obtained by rib resection. It can almost always be done with local anæsthesia; it is a simpler procedure; it makes for the comfort of both the patient and his attendants. By making possible the early use of suction drainage, it favors pulmonary expansion. It eliminates one source of chronic empyema sinuses, namely, disease of the ribs. Rib resection and major thoracotomy are to be reserved as primary procedures for specific indications. The deforming thoracoplastic operations previously practiced have been eliminated.

I am greatly indebted to Doctors Lilienthal, Berg, and Beer for the use of the case histories, to Dr. Berg for the opportunity to care for a considerable number of the cases throughout their course, and to my chief, Dr. Lilienthal, for much valuable instruction and suggestion.

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THE OPERATIVE TREATMENT OF ADVANCED PULMONARY TUBERCULOSIS[1]

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IT is generally recognized today that the therapeutic pneumothorax (Forlanini–Murphy) is of great assistance in the treatment of pulmonary tuberculosis. When it is combined with proper hygienic measures and with a régime carefully supervized by the internist or specialist, it has been found that tuberculous patients get entirely well under such treatment; that others are improved sufficiently to enable them to lead a satisfactory existence for many years.

But what if adhesions have united the pulmonary to the costal pleura, if the needle again and again fails to find a place in which the nitrogen (or pure air) can be blown in successfully; if, further, all the other measures of scientific régime do not bring improvement? Were no other treatment at hand in such a contingency these patients would be doomed. Their death would be a question of but a short time.

It is in such desperate cases and at this stage of the disease, that modern operative surgery is found of value.

At the suggestion of Brauer, then the internist at the Marburg University, the late P. L. Friedrich, then director of the surgical clinic of the same University, took up this question with Brauer in 1908. They reasoned that when the presence of far-reaching adhesions between the two pleural leaves prevents the insufflation of the pleural sac, it should be possible to accomplish the required collapse and artificial putting at rest of the diseased lung by an attack upon the skeleton of the thorax. They further argued that the collapse of the chest wall, which would follow the resection of the tenth to second or first ribs inclusive if followed by artificial mechanical compression of the thorax should produce in these otherwise hopeless cases the same final result as the Forlanini–Murphy method in the more favorable cases. Friedrich thereupon proceded to operate on the basis of this theory, resecting the ribs above mentioned, after having gained the necessary access to the bony thoracic wall by means of Schede's incision (Fig. 1). The work was done in one sitting under superficial morphine-chloroform anæsthesia. Friedrich called this operation: "Total thoracoplastic pleuropneumolysis," and considered it indicated in one-sided tuberculous affection of the lung in patients who had not yet passed the fortieth year, particularly if there was cavity formation in the upper lobe. Simultaneous, non-active and non-progressive involvement of the other lung did, in his opinion, not represent a contra-indication.

In his address before the International Surgical Congress at Brussels, 1911, Friedrich was able to report 28 cases thus operated upon with 19 recoveries. Of the latter 16 were greatly improved; 3 improved. All were desperate cases, in fact three-fourths of them were apparently beyond help as far as any other treatment was concerned.

In view of the risk involved in undertaking so serious an operation in these always weak and greatly reduced patients, Friedrich's then first assistant, F. Sauerbruch, tried to modify and simplify the Brauer-Friedrich procedure by doing it in stages and under regional and local novocaine anæsthesia. In order to avoid aspiration pneumonia of the lower lobe, from a purulent cavity in the upper lobe, Sauerbruch proceded thus: he resected the tenth to sixth ribs inclusive and compressed the thorax by means of pad and elastic straps, and 2 to 3 weeks later, added the removal of sufficiently large pieces of the fifth to second or first ribs inclusive. The first rib was rarely resected. Sauerbruch found that the posterior half of the Schede incision exposed a sufficient length of the ribs for resection (hook-incision, Figs. 2 and 3). He adopted the term "extrapleural thoracoplasty," which Spengler had coined in 1910,

[1] Read before the second annual meeting of the American Association for Thoracic Surgery, Atlantic City, June 9, 1919.

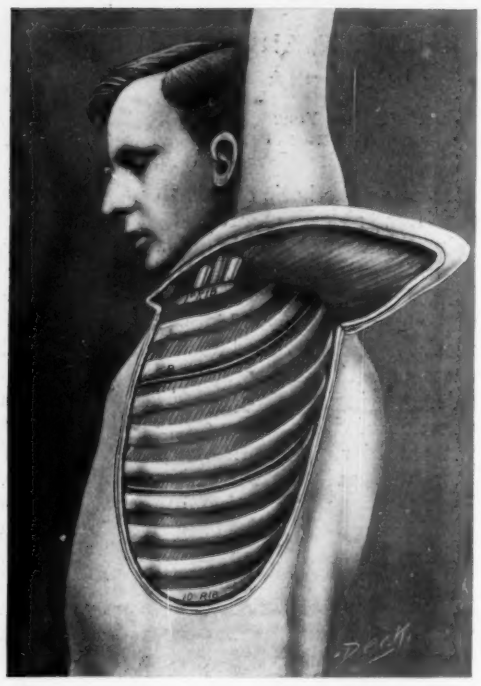

Fig. 1. Schede's incision raising a skin muscle flap including scapula, exposing the entire length of the first to tenth ribs.

for far-reaching rib resection in cases of cavernous phthisis.

Of 41 patients of Sauerbruch[1] thus operated upon 8 were cured; 7 much improved; 13 improved; 3 remained unchanged; 4 became worse; 6 died, of the latter one in immediate connection with the operation; 5 died later on. Of the 20 improved and much improved 7 gave hope for complete recovery. The last results of Sauerbruch published by his first assistant, C. Henschen, are remarkable. The number of his uncomplicated cases had risen to 122, of whom 24 were cured, 30 considerably improved, 32 improved, 4 unchanged or worse.

The cases had all been carefully selected by specialists in tuberculosis. The majority of them came down to Zurich from Davos in Switzerland and returned to the higher altitudes after their operative recovery. As a general rule, only cases with unilateral affection were considered, although *slight* affection of the opposite lung and early tuberculous involvement of the larynx, did not exclude the patient from the operation. The presence of ulcerous intestinal tuberculosis, also of recent foci in the lower lobe of the other lung, and of old foci in the region of the hilum of the opposite side, and as well advanced debility were considered contra-indications.

Sauerbruch succeeded in doing the operation, with his trained set of permanent assistants, from the first incision to the finishing of the last layer suture, in 17 to 19 minutes, a brilliant demonstration of the efficiency of "crew work," as could be witnessed by members of the Southern Surgical Club whose itinerary for the United States and Europe in the summer of 1914 took them also to Zurich.

With increasing experience, Sauerbruch undertook to do the entire rib resection (tenth to second ribs inclusive) in one and the same sitting, when conditions seemed to warrant it. If stronger compression of the lung than obtainable by the described procedure was required for the accomplishment of the desired result, viz., subsidence of fever, reduction of sputum and cough, improvement of the patient's general condition, the following additional steps were taken:

a. Resection of the first rib at the front also of a portion of the clavicle.

b. Resection of the phrenic nerve at the neck (phrenicotomy), to induce permanent paralysis of the respective half of the diaphragm on the diseased side.

c. Tuffier's operation: "apicolysis" with insertion of a plomb. The operation consists in the resection of a short piece of the second or third rib in the preaxillary line, with division of the posterior periosteal envelope of the rib, and collapsing the apex of the lung by separating the parietal plus adherent visceral pleura from the intrathoracic fascia. The resulting free space is then filled up with fat or paraffine. Tuffier preferred the fat-transplant, usually choosing a piece of omentum which he had learned to keep undecomposed in cold storage for the desired length of time.

[1] Ergeb. d. inn. Med., 1913, x.

Fig. 2 (at left). Sauerbruch's "hook incision," representing the posterior half of Schede's incision.

Fig. 3. Exposure of the posterior two-thirds of the ribs by means of the "hook incision," the inner border of the scapula being pulled outwardly.

Sauerbruch made use of the paraffine-plomb, as suggested by Baer of Davos. Paraffine of a higher melting point than the temperature of the body, is put into the cavity in small, round lumps while still moldable; there it soon hardens and forms a large, irregularly shaped, coherent mass which, when healed in, represents a permanent reliable compressorium of the collapsed apex. In 1913, Sauerbruch reported 8 operations of this kind, of which 6 were successes, and 1 improved. Up to the spring of 1914 the plugging had been carried out at his clinic in 23 patients.

Wilms, of Heidelberg, did not fear aspiration pneumonia in the lower lobe as a result of multiple rib resection in the presence of a cavity in the superior lobe, at least not in the milder cases. He favored what he termed "columnar resection" of the upper 7 or 9 ribs, anteriorly and posteriorly in one sitting (Fig. 4). The intermediate portion of the ribs, which is left in place, is utilized for the compression of the lung. Wilms also employed regional and local anæsthesia. He reports 12 cases without mortality and with satisfactory results. Sauerbruch considers it advisable to use this procedure only in non-cavernous tuberculous affection of the upper lobe.

The cases reported by these three authors constitute the largest series of its kind so far published. It is interesting to note that their operative results are almost identical: two-thirds (or more) of the patients were either cured or improved,—certainly a remarkable record.

Sauerbruch also led the way in employing the same procedure—subsequent to ligation of branches of the pulmonary artery—for the treatment of bronchiectasis, and as, for reasons which will appear below, it is only in that type of cases that, until very recently, I personally have been able to do thoracoplasty, I beg leave to be permitted to deviate for a moment to the discussion of the treatment of bronchiectasis.

I have done extrathoracic thoracoplasty in advanced bronchiectatics seven times in the course of the last ten years. For this class of cases the operation represents but one of the many "conservative" procedures which have

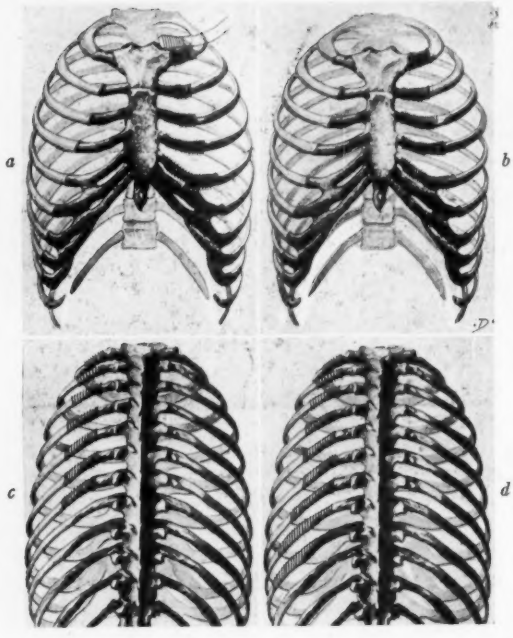

Fig. 4 *a–d*. Illustrating Wilms' "columnar resection" of the ribs. *a*. Resection of the cartilages plus adjacent portions of the upper five ribs, also of the sternal extremity of the clavicle, in order to increase the contemplated compression of the diseased lung. *b*. Same as *a*, without the additional operation on the clavicle. *c*. Resection of the upper seven ribs in the region of their angle. *d*. Same as *c*, operation involving the nine upper ribs. Note the increasing length of the resected portion of seventh to ninth ribs. (From *Muenchener medizinische Wochenschrift*, 1913, p. 450-451.)

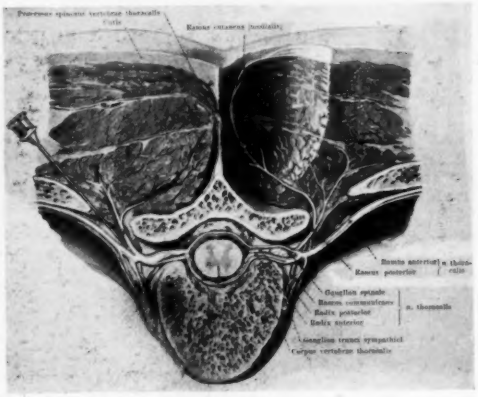

Fig. 5. Transverse cut through dorsal spine with muscles of back. The needle has been added by author in order to point to the efficiency of this regional anæsthesia if the method is carried out correctly. (From *Spalteholz, Handatlas der Anatomie des Menschen*, vol. iii, Fig. 690.)

been proposed for the surgical treatment of these unfortunates.

It was the above-mentioned late Prof. Friedrich who, at the time of his visit to our country, in 1909, counseled me to practise conservatism in treating surgically patients suffering from advanced bronchiectasis. He was of the opinion that the less dangerous operations should be tried before resorting to lobectomy. He was afraid that the youngest and last child of operative surgery, "thoracic surgery," might not gain the confidence of our medical confrères and of the general public, if too many deaths were reported as a result of a too aggressive surgery.

I took his advice, and performed a number of these conservative operations for bronchiectasis. Today I look back upon this series of bronchiectatic operations partly with regret and partly with satisfaction; with regret, because I failed to cure a number of advanced cases who might have had a better chance with properly performed lobectomy; with satisfaction, because I succeeded by patience and perseverance in saving, even curing a few greatly reduced patients, who would most likely have succumbed to more radical work. My experience has led me to believe that even quite advanced cases of bronchiectasis can be very greatly improved by operations less dangerous than lobectomy. At the present moment most careful individualization in establishing the indication for operation is required in this class of cases. However, there can be no doubt that in the very advanced stage of bronchiectatic affection, *only the extirpation* of the diseased lobe or lobes of the lung, lobectomy, can bring permanent relief.

Looking back, a further source of satisfaction in prolonged conservative operative work in this branch of thoracic surgery has been to me, that I have made early acquaintance with extrapleural thoracoplasty, done under regional and local anæsthesia. As stated before, I performed this operation seven times in these patients, in a few instances

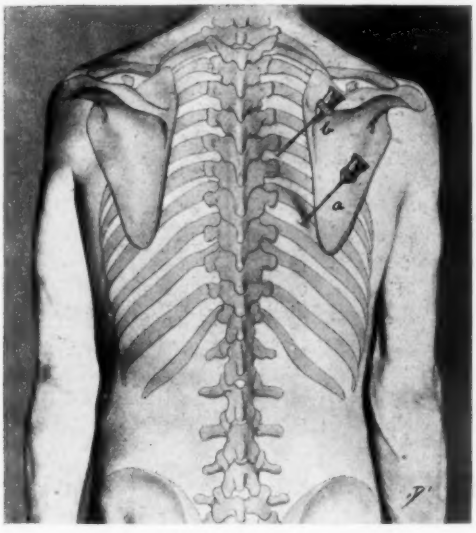

Fig. 6. Diagrammatic illustration of the location where the needle is introduced in Schumacher's, *a*, and Kappis', *b*, methods. In practice the needle at *a* has to point upward and inward and run close to the rib.

Fig. 7. The same with the patient in the abdominal posture, lying horizontally on the operating table. (In the picture the table has been tilted in order to allow the artist to photograph the entrance of the needle in the back.)

resecting all the upper ribs, from the tenth to the first inclusive, in one sitting. During the entire course of some of these operations I could converse with the non-narcotized patients.

It was but natural that I was eager to try to save by extrapleural thoracoplasty also suitable patients with advanced tuberculous affection of the lung, in whom therapeutic pneumothorax was not feasible. However, for many years past, insurmountable obstacles presented themselves. Thanks to the high state of education of the public in matters tuberculous, and thanks further, to most stringent rules of the health authorities, patients with active tubercle bacilli in their sputum are refused admission to the public wards of our hospitals, and the boards of trustees likewise refuse their admission to the private division. For more than seven years I have vainly tried to get these cases admitted to isolated parts of the hospitals with which I am connected. The war prevented the carrying out of promised arrangements in the thoracic pavilion of the Lenox Hill Hospital.

It is necessary to have these patients operated upon in a place where the surgeon is in easy reach and where the patient can be under the continuous attendance of trained nurses, for, next to careful aseptic work under regional and local anæsthesia, the success of the operation depends largely on most vigilant and efficient nursing and constant intelligent supervision of the patient during the first few days after the operation.

Some months ago the subject was taken up again before a meeting of the Board of Trustees of the Lenox Hill Hospital, and after a lengthy discussion permission was obtained for such patients to enter the isolating house. Fortunately, the superintendent gave me the use of a rather isolated room on the top floor of the hospital proper for the surgical treatment of these cases. Here my first patient, thus operated upon, recovered:

L. S., male, 26 years old; suffering from tuberculosis of the left lung for the last 7 years; has been residing, in chronological sequence, in Saranac Lake, Colorado, New Mexico, New York, and again in Saranac Lake. Tubercle bacilli were first found in 1914. He had repeated attacks of hæmoptysis in 1916 and 1917. The establishment of a therapeutic pneumothorax being found impossible on account of extensive adhesions, Drs. Baldwin and Trembley of Saranac Lake kindly sent him to me for operation. The patient appeared very delicate, was short of breath on slight exertion and had a rapid pulse. Every few weeks, following a slight chill, his temp-

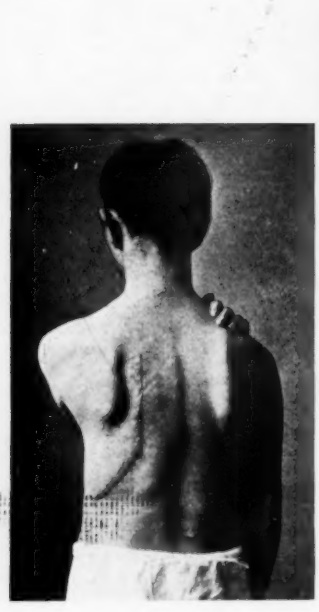

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 8. Appearance of scar after first operation. Resection of tenth to sixth ribs.

Fig. 9. Compression pad in place covering dressing.
Fig. 10. Compression pad in place (rear view).

erature would rise to 103° and more, coming down to normal gradually. Clinically the left lung showed all the signs of far-reaching tuberculous infiltration with multiple cavity formation. Quantity of sputum, 60 cubic centimeters in 24 hours.

It was decided to take the safest course, as advised by Sauerbruch and do the rib resection in a two- or even three-stage operation. November 18, 1918, first stage. Regional and local novocaine-adrenalin anæsthesia (Kappis and Schumacher).[1] After infiltration of the desired line of incision, the Kappis method is carried out first (Figs. 5, 6, and 7), 2 cubic centimeters of the anæsthetizing solution being deposited after striking the rib with the needle, and 8 cubic centimeters around the posterior roots of the thoracic nerves near the spine. The Schumacher method in weak proportion, is then added (Fig. 6a), 5 cubic centimeters of the fluid being deposited at and below the angle of the tenth to sixth, inclusive, left ribs, 150 cubic centimeters of the solution in all. This combined course of anæsthetization was taken to insure greater success. After some temporizing, during which the patient was finally prepared for operation, the lower portion—about three-fourths—of the typical posterior hook incision was painlessly carried out (Fig. 2), the scapula pulled aside (Fig. 3), and pieces of bone, 10 to 15 centimeters long, excised well beyond the angle, from those ribs. With two long split drainage tubes in place, the wound was sutured in layers with a continuous stitch, and the dressing held in place by broad zinc adhesive plaster which also fixated the arm. The drainage tubes having been removed on the third day, the wound healed quickly by primary union. Thorax compression was made by means of a pad and elastic strips buckled to a ring surrounding shoulder- and hip-joint of the opposite side. Two weeks later the patient was out of bed, improved in every respect.

On December 5, it was considered timely to do the second stage on the fifth to second ribs, inclusive, again avoiding general anæsthesia (Fig. 11). Only a few drops of anæsthol, 20 cubic centimeters in all, were given, more to quiet the patient, than to alleviate the pain. But, in order to expose a sufficient length of the ribs it became necessary, at the second stage, to re-incise the entire length of the first cut. The regret felt at having to destroy the nice primary union (Fig. 8), suggested the thought of trying to do the required resection in one stage in the future, at least in patients not too greatly reduced. The stumps of the ribs resected at the first operation were found covered with glistening white connective tissue of remarkable thickness. Again, drainage and dressing were applied

[1] See Ann. Surg., 1917, lxvi, 401.

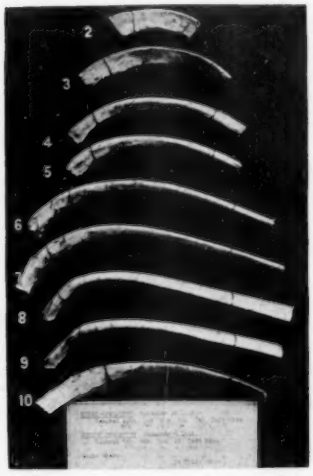

Fig. 11. Resected portions of second to tenth ribs.

Fig. 12. Scar as it appears today with resection of tenth to second ribs completed.

as before. The patient made an uninterrupted recovery. He was out of bed on the sixteenth day. Compression was made with larger and smaller pad day and night (Figs. 9 and 10). Soon the sputum decreased in amount and the coughing spells became less frequent. The patient gradually gained in weight; the bacilli disappeared after the first operation and have not been found again.

Today the patient is greatly improved; he is back in the mountains. Under date of March 25, he reports continued good progress, increasing weight (128 pounds), pulse 60 to 70, temperature never above 100°, hardly any expectoration, and he feels pretty strong. On May 25, he writes: "Weight increased to 136 pounds; I feel fine." (The patient was presented before the meeting, Fig. 12.)

Considering the fact that this patient would have been hopelessly lost at an early date without operation, his present condition certainly is a source of great satisfaction.[1]

[1] Another much reduced male patient with advanced right-sided tuberculosis of the lung (cavity formation) came to me for operation through the courtesy of Dr. Robert C. Paterson of Saranac Lake, in December, 1918. He, too, had been sick for many years; he coughed a great deal, was desperate and demanded operation as a last resort. He clearly was a bad risk. Subsequent to the first stage of the extrapleural thoracoplasty he developed a continuously high and irregular fever, commencing on the third day after the operation. Paravertebral resection of the sixth to the tenth ribs inclusive had again been done by means of the hook incision under local novocaine anæsthesia; the operation was well borne. All attempts at improving his condition being without avail, the patient was, with Dr. Paterson's consent, brought back to the mountains, but died there soon after. Partial postmortem (Dr. Paterson) revealed a pronounced disseminated tuberculosis of the opposite, left, lung, less of the one on the operated side. Such dissemination has been found to be a rather rare occurrence after the plastic operation. It has to be looked upon as representing a sudden activation of hitherto quiescent foci, the sudden absorption of toxin during the first stage of collapse of the lung, causing a postoperative tuberculous reaction. It is an interesting fact that a hæmatogenous spread of the tubercle bacilli, with subsequent development of a general miliary tuberculosis has never been observed after "indirect" operation, neither after the establishment of a therapeutic pneumothorax nor after the extrapleural thoracoplasty, (Henschen loc. cit.).

The immediate results of the far-reaching collapse and pronounced compression from all sides of the affected lung, are the following: Proliferation of connective tissue; gradual carnification of the elastic lung tissue and reduction in size of former cavities; onset of a chronic hyperæmia (according to Cloëtta's careful investigations), which, works in the sense of a Bier's hyperæmia and causes the tuberculous infiltration to be replaced by permanent scar tissue. Inactive foci of the opposite lung are often beneficially influenced by the operation.

Hand in hand with the local organic improvement, the subjective condition of the patient points to a steady change for the better. Cough and sputum become reduced or cease; bacilli disappear; fever and night sweats stop; the body-weight increases.

Thus hope, *well-founded hope*, may still be held out to a certain number of these patients who often have been battling bravely for years, and formerly could see no way out.

There can be no doubt that advanced and otherwise intractable pulmonary tuberculosis, particularly in cases of pronounced unilateral cavity formation, has become a distinct border-line disease, and that the operative surgery of today offers substantial hope of even a cure to many of these despairing patients.

RAPID EXPULSION OF THE PLACENTA

By Dr. GEORGE SKLAVOUNOS, Athens, Greece
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IT is well known that two methods are employed to obtain rapid detachment of the placenta; the external, or Credé method, and the internal, or the intra-uterine use of the hand. All specialists in obstetrics agree that both of these methods cannot be used without a certain amount of danger, and this is especially true when practiced by unskilled hands. The weak point of the Credé method is that there is the danger of crushing the muscular coat of the uterus, thus provoking rupture in the further course of delivery of the placenta. The extirpation of the placenta by the hand is a violent procedure which can be employed without danger only by specialists and under strict aseptic precautions.

When I first saw the umbilical cord hanging from the orifice of the vagina in cases of retained placenta, I thought that in this way nature had given us a means of delivering the placenta without injuring the uterus. The idea immediately occurred to me to inject in the umbilical vein boiled water, which had been prepared for intra-uterine injection, to provoke the pains. Thus I hoped to excite the muscular coat more intensively and secondly to increase the weight of the placenta which would then be separated more easily. But I refrained from trying the procedure on the living as I wished to make some experiments first on expulsed placenta.

About the end of October, I injected into the omphalic vein a sufficient quantity of salt water to fill only the veins of the placenta up to the capillaries, as the arteries were obstructed by clots. Later on, I succeeded in filling the arteries with hot water. These anatomical experiments fixed the quantity of water necessary to fill the veins only, at 200 grams; the amount reached 250 grams when the arteries were also filled.

The increase in weight of the placenta to half of its normal weight (500 to 600 grams) and the subsequent overswelling of the villi would act strongly upon the uterus to bring about the detachment of the placenta. It was my belief that the injection of salt solution through the omphalic veins in the cord of the living would do no harm; consequently, I mentioned my idea to Professor Petsalis and Dr. Negrepontis who readily gave me permission to apply my method on lying-in women. Thus, assisted by Dr. Adrianakos, I tried the method in 30 cases in the University Lying-In Hospital. I wish to express my thanks to each of these colleagues.

I was present during the administration of this method in 7 of the 30 cases, and in these 7 cases the method was successful. For the most part the results in the remaining 23 cases, which Dr. Adrianakos attended, were also successful. When I say successful I mean that, by the application of this method immediately after the cutting of the cord, the placenta was expelled spontaneously within 3 to 5 minutes, and without any other manipulation. In a few instances the injection was not entirely successful and the Credé method had also to be used.

The failures were due to imperfections in technique: (1) the cannula was inadequate or too sharp, thus sometimes injuring the wall of the vein; (2) we divided the cord too far from the orifice of the vagina, thus the veins in part of the cord exposed to the air were filled with clots, and when the clots were pushed along by the solution injected, they obstructed the internal branches of the vein and rendered injection incomplete or provoked rupture of the vessels; (3) the central part of the omphalic cord was tied (as was the usual custom) and as it was filled with clots the injection was hindered. When these imperfections were avoided the injection was always successful.

APPLICATION OF THE METHOD

The necessary instruments are: (1) an ordinary syringe; (2) a metallic cannula attached to the distal end of the rubber tube

(this cannula must have a perimeter of 1.5 centimeters and a groove behind the lumen to prevent slipping of the cord when attached to the cannula); (3) a pair of scissors and a clamp. Except for the cannula, this represents the usual outlay of instruments used by the midwife. The instruments are sterilized and we add 15 or 20 grams of salt to 1,500 grams of sterilized hot water (temperature 50 to 60° C.). This done we place the syringe 2 yards high and wait for the expulsion of the child. After the birth of the child and the cord is tied, we cut the superfluous part of it, allowing it to remain 3 or 4 inches from the vulva, pressing it off to let the blood flow. In doing this we stand at the right side of the patient. We then hold the cord with the left hand and turn it up so that we can see the wide lumen of the vein. Now we take the clamp with the right hand and put the one branch in the lumen and the other on the surface of the omphalic cord. We then press the clamp, thus immobilizing the vein which would otherwise easily slip away inside the whartonian jelly. We then introduce the cannula in the immobilized lumen of the vein and instruct the assistant to tie about the groove in the cannula, thus tying at the same time both the omphalic vein and arteries. If the vein slips we must try again. When the knot is firm we inject the salt solution into the vein which swells and takes on a white instead of the previous blue color. After two or three minutes, we can see the swelling of both omphalic arteries which become blue in color from the blood pushed into them through the capillaries by the force of the injection. The swelling of the arteries proves that the injection has been successful. So soon as 200 grams of salt solution are injected, detachment of the placenta begins, and as detachment gradually progresses the water flows more quickly from the syringe while the thin blood mixed with water flows from the orifice of the vagina. To fill completely and to wash out the blood from the internal vessels of the placenta, we cut with scissors first the one and afterward the other omphalic arteries. If the injection has been correctly done, we see the blood springing out at a certain distance. When the blood has been washed out and water comes from the arteries we press them with a clamp and await the result of the injection.

To prevent the clots in the vessels and facilitate the circulation of the injected liquid I add lately 2 per cent sodium nitrate in the salt solution. The results obtained with this solution have been better than with simple salt solution.

CLINICAL SIGNS

We observe the following subjective phenomena. One to two minutes after the injection, the parturient has a burning sensation inside; two to five minutes later, she suffers pain due to the commencing uterine contraction. Objectively, the following phenomena are observed: Two or three minutes after the beginning of the pain a little blood flows from the orifice of the vagina, the fundus of the uterus comes higher up, and the cord slides 4 or 5 inches away from the orifice of the vagina. These phenomena show the detachment of the placenta, which lies now between the cervix and the vulva in the vagina, where it may remain for two to four minutes. A strong bearing-down strain is required or a light pressure over the fundus to complete the expulsion of the placenta which appears at the orifice, swelled with the distended vessels. Expulsion of the placenta is followed by expulsion of the membranes.

In the first cases the delivery of which I attended, as soon as the placenta was expulsed the midwife in attendance twisted it, together with the membranes. I asked that this procedure be omitted because the membranes are easily separated without it.

But the most important clinical signs after the expulsion of the placenta are: (1) the complete and regular contraction of the uterus which becomes nearly as hard as a stone, and (2) the stopping of the bleeding. These advantages were observed by my assistant, Dr. Adrianakos, and confirmed afterward by the first assistant, Dr. Negrepontis, in cases of inertia of the uterus.

I shall refer later on to the anatomical construction of the placenta in the cases in which my method may be applied.

EXPLANATION OF THE DETACHMENT

To explain the mechanism of the rapid separation of the placenta, by the procedure described, it is necessary to recall some anatomical considerations. The placenta consists of two parts which are connected. One part, the embryogenic, is thicker than the other and is the continuation of the omphalic cord; and the other, the metrogenic, thinner part is formed from the chorium of the mucous membrane of the uterus and is called decidua. These two portions communicate by processes; those of the embryogenic part are called villi and those of the maternal part, partition walls. But the union of the two parts is of loose texture and relative, because between the parts it remains a highly wrought space between the villi, in which on the one hand the metroplacental arteries pour their blood and on the other the metroplacental veins. By means of this space, the maternal blood circulates, and in it swim and are implanted the villi of the embryogenic portion.

The metrogenic portion is formed of two layers: The first is more compact and is united firmly with the villi which, demarcated in lobes, constitute the cotyledons. The second is a spongy substance made up of minute bundles and leaves by means of which it is united to the uterine muscular coat. In this spongy layer is brought about usually the separation of the placenta.

The embryogenic portion is a disc, about 2 centimeters thick, the surface of which is turned to the metrogenic portion and bears numerous free villi running in the space between the villi or implanted by their top in the metrogenic portion (decidua). This construction is similar to that of the umbilical cord which at its end toward the uterus is expanded and implanted in the uterine mucous membrane by numerous rootlets, the villi. The cord contains three vessels, two arteries, and one vein, which in the interior of the villi are united by a capillary network; consequently, if we pour liquid from one of the arteries it will pass through the capillaries of the villi to the umbilical vein; and inversely if we pour liquid in the vein it will pass through the capillaries to both arteries. If injection were tried in the vein of another organ, it could not be accomplished on account of the valves; but the umbilical vein is generally without valves.

Having mentioned their fundamental features, I will try to explain what occurs in applying this new method. The explanation is not complete as the result of the histological examinations is still wanting. However, I believe that many factors help to bring about the separation of the placenta. These are: The increase in the weight, the swelling of the villi, the infiltration and rupture of the capillaries of the villi, and lastly, the temperature of the injected solution. These factors act chiefly on that part of the muscular coat of the uterus which is connected with the placenta and which does not, like the other parts of the uterus, contract immediately after the expulsion of the fœtus. The weight increases considerably by the injection, increasing more than half the normal weight. The thin layer of the spongy substance is dilated and thus the fibers of the neighboring muscular coat of the uterus are stimulated and contract. The result is a bursting of the fibers in the spongy portion. We do not know whether the increase in weight alone is capable of separating the placenta, because we cannot exclude the action of the other factors during the experiment. To determine this point, I tried metallic mercury in some experiments on expulsed placenta, but I believe that this is not yet permissible in the living.

A second factor is the erection of the villi which results from their overfilling. The erection and the swelling of the villi cause some shaking of the cotelydons from their coat as if they were, so to speak, lifted by lever action, while at the same time the adherent villi are ruptured. Bearing in mind that some of the villi go deeply into the decidua bringing with them the choriodecidual vessels, we can understand that the erection or the rupture of the villi assists also in the separation.

The third factor is the infiltration of the salt solution behind the placenta. This I have proved by adding methylene blue to the injected liquid. When the placenta was

expulsed it had large blue stains on its implanted surface. But the best demonstration is the experiment on the parturient. Here after the separation of the placenta has commenced (i.e., after the injection of 200 grams), the liquid falls abruptly in the syringe, while watery blood flows from the orifice of the vagina, which at first may cause the observer to fear that hæmorrhage is taking place. But this fear is soon dismissed by the state of the pulse. As a matter of fact the liquid is some blood mixed with the injected solution. If the pressure is increased this watery blood becomes more abundant and assists in the more rapid separation of the membranes.

The importance of infiltration of liquid behind the placenta is shown by nature herself. Nature uses the same process to accumulate blood behind the placenta; so-called retroplacental hæmatoma resulting from the rupture of vessels lying between the uterus and the placenta.

Further histological examination of the placenta will prove exactly where the infiltration or rupture of the capillaries occurs. I suppose that first it fills the space between the villi, canalized as it is known by the final venous sinus and uteroplacental veins. Were the muscular part of the uterus connected with the placenta not contracted, then the liquid could, of course, enter the uterine circulation and the stagnation in the intervillous space could not occur. But the immediate muscular contraction of the uterus compresses the veins as would a clamp and the injected liquid distends the final sinus and infiltrates the spongy layer, all this resulting in rupture of the cotyledons and the uteroplacental vessels.

Two other important questions have arisen in regard to infiltration; i.e., first, whether the passage of the liquid is due to the strength of the solution (hypertonic); and, second, how the passage of the solution through the villi to the decidua is effected. Tests were made by adding to the solution injected a colored, sterilized substance and later making histological examinations of specimens expulsed.

Last but not least we must consider the heat of the solution as a factor in bringing about the separation. The heat may act on the final nerves or directly on the muscular coat of the uterus and chiefly on the deeper villi (choriodecidual vessels). The action of the heat is reinforced by the salt which excites contraction in the muscular fibers. One might think that the same action could be obtained by a simple intra-uterine injection of hot water, in which case the injection of the omphalic vessels would be superfluous. To this objection I answer first, that the intra-uterine hot injection is not sufficient to accomplish results as the thickness of the placenta and the membranes prevents the action of the heat upon the muscular coat; second, that the intervillous injection as accomplished by my method acts directly upon the muscular coat by a sort of spray from numerous minute springs. Hence the effect is quick and constant and the contraction of the uterus strong. This is the explanation that I offer for the injection in the omphalic vein. The general application of it will show later on, which of the factors mentioned above is more important and whether or not other factors contribute also to the final result. If we compare my method with that of Credé I may perhaps say that my method is superior to the latter. The Credé method has a certain amount of danger connected with it, because it embodies rough manipulation of a very vital and delicate organ, the uterus, while my method is safe and gentle and gives tone rather than causes injury to the uterine muscular coat.

One might object that from the point of view of the practical accoucheur, the most important thing, is the detachment of the "placenta accreta." I had only one case in this category. The Credé method was applied without result and then instead of proceeding with the hand a hot intervillous injection was used and resulted in the detachment of the placenta only a little later than usual. One case cannot, of course, prove the point. However, I have two other cases in which forceps were used on account of uterine inertia. In both cases, after injection the placenta was expulsed within five or six minutes and the uterus was completely

contracted while bleeding was immediately stopped. I think that the question of the quick detachment of the normal placenta is definitely settled. The use of the method described will convince every one that its effectiveness consists, first, in the immediate and complete contraction of the uterus, and, second, in the suppression of any bleeding, which is important, as postpartum hæmorrhage has a bad effect upon the mother during childbed and nursing.

The question of the application of this method in the treatment of retained placenta remains unsettled, because the number of cases in which the method has been used is not yet sufficient to estimate results. But I think that even in such cases the method will be effective if, as Bumm believes, the retention of the placenta is not due to inflammation and firm adhesions, but to other still unknown causes. As the method has not as yet been used in such difficult cases, I publish this paper hoping that the method will be used by others and their findings recorded.

BIBLIOGRAPHICAL NOTE

While this paper was in process, my distinguished colleague, Dr. Andreou, drew my attention to the *Handbook of Therapeutics*[1] in which the separation of the placenta by the "cold injection of the omphalic vein of Mojon" is mentioned. I then searched the literature and found that a hundred years ago, the Italian professor of anatomy and physiology in Genoa, Benedetto Mojon, first described the detachment of the placenta by the injection in the umbilical cord, in a paper entitled *Sull' injezione dell' placenta*, Livorno, 1826. This paper is not in the possession of the Italian national library but I found a brief description of the Mojon method in the obstetrical work of S. Kanzoni[2] who obtained good results and recommends its use.

It is difficult to explain why this logical method was completely abandoned. I suppose the lack of asepsis and the use of cold water which would make the injection impossible because of clots in the capillaries and omphalic arteries rendered the application difficult and dangerous.

Although using the same route (omphalic) as that of Mojon, my method is different in many ways: (1) it conforms to the new methods of aseptic obstetrics; (2) it produces a complete filling of the vascular system of the placenta and therefore a swelling of the villi; (3) the injected hot water increases the natural hæmatoma behind the placenta; and (4) the injection is made with hot hypertonic salt solution to which I have lately added 2 per cent citrate completely to dissolve the clot.

Up to the present time more than 60 cases have been successfully treated in the University Lying-In Hospital, of Athens. I believe that the method is especially suited to the man who practices under great difficulties in the little town and village, and who would hesitate to introduce his hand into the vagina when he is able to obtain the same result with a simple and safe method.

[1] Traite pratique des accouchements, ii, 487.

[2] 4th ed., 298.

STERILITY[1]

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DORLAND (4) defines sterility as inability to produce young, or barrenness, while Polak (29) defines it as the inability of a woman to produce a living child. It is difficult to agree with the latter definition for surely a definite pregnancy precludes the application of the word sterile to a woman.

It has been questioned whether sterility is a disease or a symptom; it depends upon the case. If there are many gross lesions in the pelvis and sterility is present, the latter is a symptom; if, however, a woman is sterile and the pelvis and her constitution generally are found to be normal, then sterility is a disease, and it is a disease which causes many symptoms, neurasthenia being the most prominent.

Female sterility concerns us chiefly here, but it is impossible to consider this subject without bearing in mind that the male may be at fault. If a woman who is sterile has some definite lesion which may be a possible cause of her sterility, that lesion must be corrected. If no lesion is apparent it is necessary to examine the semen. A sufficient and satisfactory examination is made by means of a condom. Huehner (15) does not consider this sufficient as he says not only must the number and vitality of the spermatozoa be considered, but also the power of the penis to ejaculate the semen so that it reaches the cervical os; in fact, Huehner says that the only test that the male is normal is that live spermatozoa reach the cervical os. It is simple to ascertain the power of the male by questioning him. While the so-called effluvium seminalis is present in some cases of sterility it is not invariably so, and as it is sometimes found in fruitful women it is not a sign of much moment.

For all practical purposes a marriage may be considered sterile when pregnancy does not occur after 18 months.

Various classifications have been attempted by different authors and it is unnecessary to mention them all here. A classification which embraces all varieties is, first, due to the man; second, to the woman: and to subdivide these into absolute, when some organ necessary for conception is absent; relative, when there is no such absence but either the man or the woman is sterile. There is an old wives' tale that twins cannot have children, or if they have children, the sex must be the same. Both these ideas are untrue, and if one of a pair of twins is sterile there is some pathological condition present.

In dealing with the subject of sterility rules must be laid down to be followed in a given case.

When the patient seeks advice, her history, general and gynecological, is taken. Questions are asked as to the performance of the sex act; if the answers are unsatisfactory, instruction is given. Enlargement of the thyroid gland, when presented, is noted. The breasts are examined and maldevelopment sought for. The abdomen is thoroughly investigated. Excessive obesity is especially of moment. The latter is frequently found and is said by Opitz (26) to be due to some fault in thyroid secretion. Weil (38) also agrees that sterility is in certain cases due to disturbance of the hormone action of the thyroid, while McKee (21) says that sterility is due to fat causing maldevelopment of the ovaries. Whatever cause it is due to, fat patients who are sterile, often become pregnant after being placed on a suitable diet and being given glandular extract. Horrocks (14) gave the capon as an illustration of sterility in conjunction with obesity. The vulva is next inspected for any signs of inflammation, painful urethral caruncle, intact or inflamed hymen, maculæ, gonorrhœa, tumors or other abnormality. If present they are treated by the recognized methods. Having examined the vulva, the vagina is explored digitally and with the speculum. Stenosis of the vagina with its resulting vaginismus and dyspareunia is a most common cause of sterility. This condi-

[1] Abridgment of presidential address given at opening meeting of the Dublin Biological Association, October 25 1919.

tion is sometimes hysterical and can be overcome by suggestion together with advice to the husband. Vaginismus may also be caused by vulvar tenderness; a little cocaine ointment applied before coition often acts as a cure. When definite stenosis of the vagina is present, it is found in most cases near the vulvar orifice and is due to rigidity of the large pelvic muscles of support as chiefly represented by the levator ani muscles. The treatment in these cases is as follows: the first two fingers of each hand are placed in the vagina and the latter is stretched until a tearing of the fibers is felt: a Sims glass speculum of a size which will fit exactly into the vagina is next inserted. A larger size is introduced every second day for a week. A recent treatment suggested for stenosis of the vagina consists of an operation which is called "enlarging of a tight perineum" (Graves, 8). Any uterine or adnexal abnormality is corrected. Vaginal cysts are sometimes found. These are usually congenital in origin. They may cause sterility by acting as a mechanical impediment in coition or by acting as a barrier to the entrance of spermatozoa into the cervix. Other tumors of the vagina may be present. Although I have met with several cases of cyst in association with sterility I have never met with any other vaginal tumor in these cases. When present cysts are removed.

Before withdrawing the speculum, the reactions of the vaginal and cervical secretions are examined. In this connection Huehner (15) whom I have already quoted seems to have found a vast number of cases where the cervical secretion was changed. The vaginal secretion, as is well known, is acid; the cervical secretion is alkaline. Spermatozoa can live in the vagina according to different authorities for a period of from 3 to 12 hours. This might lead the unwary to prescribe alkaline douches in all cases of sterility. While this might be successful in a few cases, the douching if persisted in might easily cause a vaginitis which would lead to dyspareunia with resulting sterility from that cause.

Huehner (15), Polak (29), and many others have drawn considerable attention to the quality of the cervical secretion, and sterility is attributed to acidity in a great number of cases. Reynolds (32) has noticed that the cervical secretion is sometimes sticky and may entangle the tail of the spermatozoon. It has not been my experience to find an absence of alkaline secretion in more than half a dozen cases, and in these there were other conditions present which were corrected by operation. In patients who have a cervical secretion which is not markedly alkaline, a douche of phosphate of soda, one drachm to the pint, is ordered just before coition.

Spermatozoa, as stated above, die in the vagina in about 3 hours; they live in the cervix for 6 to 8 days. This is an important point to bear in mind, not only from the view of treatment of sterility but from the standpoint of legitimacy. The law has ordained that a child born 304 days from coitus is legitimate; it is to be supposed that the learned judge took into account the period which the spermatozoa spent in the uterus or the tube before fertilization occurred. Even then there were good grounds for doubt.

While the speculum is still in the vagina, the cervix is carefully examined. Erosion, conical cervix, and pinhole os are sought for. If a pinhole os or stenosis of the cervix is present, the treatment consists in dilatation by means of Kelly's modification of Hegar's dilators, then in insertion of seatangle tents or stem pessaries. The latter instrument which was invented by Miller in 1903, although recommended by many learned gynecologists such as Norris (25), is to be heartily condemned. In a discussion in 1917 on their use, Kolischer (16) was the only one against them. The idea of leaving in the uterus for some time a foreign body which might very possibly cause salpingitis is contrary to the principles which I hold, that a septic condition of the fallopian tubes is the most common cause of sterility. For the same reason tents which take time and care to sterilize properly and which must remain in the uterus for a considerable period are not recommended. In using the metal dilators, experience teaches the size necessary to secure sufficient dilatation. A No. 10 dilator of the ordinary Kelly-Hegar type is ample. Mundé (24) and other writers have urged that the dilated cervix closes after dilatation and that the cure of sterility is effected not by

the mechanical effect but by some unknown action on the nerves of the uterus. Probably both aid. It is not necessary to place a glass dilator in the cervix as suggested lately. If a piece of 1½ gauze is placed in the canal for 24 hours, after the dilatation, an examination 3 months later will reveal no stenosis. Care must be taken not to tear the cervix in dilating, or an endocervicitis or possibly a pelvic cellulitis will result. So long ago as 1874, Beck (1) stated that the aspiratory action of the uterus was proved; also that in coition the os opened, had a rhythmical action and became soft; and that there was a tilting of the uterus toward the vagina. This belief has been shared by other investigators. If an erosion is present it should be removed, for the discharge which arises from the outer surface is inimical to the spermatozoa. There is no good object attained by palliative treatment. This last observation is made with the excellent monograph by Leonard (18) before me. Leonard in his conclusions gives the reason why partial amputation of the cervix fails. He says: "Four-fifths of the women remain sterile after the operation; yet *in certain selected cases of persistent sterility*[1], amputation of the cervix seems to be the only practicable procedure. This postoperative sterility is probably mechanical in origin and may be due rather to narrowing of the external os through encroachment by the edges of the vaginal mucosa or to a stenosis of the cervical canal. Pavlik (28) bears testimony to all the bad things Leonard states about the operation. My experience is very different and I have had many cases to prove this. Goldberger (8) agrees that conception is just as frequent after a properly performed amputation as before. *In other words, the operation must be properly performed.* Palliative treatment does not and cannot cure an erosion; a carefully performed Schroeder's amputation will do so. An hypertrophied cervix is often found in cases of sterility. It causes sterility mechanically by lengthening the cervix and where there is great length by causing dyspareunia. A circular amputation of the cervix should always be done in these cases. Before leaving the cervix, two well known operations must be mentioned, namely: Pozzi's and Dudley's. The former which was described in 1909 was practised by me soon after its description was published. It consists in the bilateral division of the cervix and the keeping open of the cervical canal by means of sutures. Pozzi (30) uses silver wire. It did not appeal to me and I discontinued it. The old operation of simple splitting of the posterior lip of the cervix need not be considered. The modification of Dudley's posterior division is extremely useful in some cases, for example in the case of a retroverted, anteflexed uterus in which the os uteri is pointing forward and in which the resulting operation brings the os pointing to the receptaculum seminalis. This operation has one great disadvantage: it is easy to perform and from results I have seen, the easiest to perform badly. Many times have I observed the leucorrhœa discharge pouring from the unhealed edges of the posterior division wound, a condition in sterility most difficult to cure. If this operation is done in selected cases with great skill, it will be found of benefit. Blair Bell (2) has done the same operation on the anterior lip, but it appears to be an irrational procedure.

Tumors of the cervix are occasionally a cause of sterility, the most common being the pedunculated submucous myoma. This, when present, must be removed. Malignant disease of the cervix is practically never seen. In fact, it has been demonstrated that parity and cancer of the cervix go hand in hand (Since writing this I have had to perform a Wertheim operation for cancer of the cervix in a sterile woman of 31).

Having considered the cervix, the body of the uterus must be brought forward as the next offender. It may act as a casual factor in many ways: first, endometritis may be present. In making use of the word endometritis, dangerous ground is being invaded, for at the present time it is a moot point what endometritis really is. I look upon it as a condition which shows itself by symptoms; in other words, a woman may be considered to have endometritis who has heavy and frequent hæmorrhages which condition is relieved by curettage of the uterus, the curettings being later examined by a competent microscopist and diagnosed as such. It is dif-

[1]My italics.

ficult to agree with Hitschmann and Adler (13) and their followers who believe only in chronic interstitial endometritis and who say that glandular endometritis does not exist. The most logical classification of chronic endometritis seems to me to be: (1) chronic interstitial, i.e., of infective origin; (2) chronic glandular, being subdivided into hypertrophic and hyperplastic, of congestive origin. Take whatever division is most pleasing, the fact remains that the relief of the symptoms by curettage of the uterus carefully performed is a most useful adjunct in the treatment of sterility. In speaking thus of curettage it is necessary to utter a word of warning. It is a common belief among laywomen that curettage will cure all cases of sterility. This, of course, is a fallacious belief and leads to a wholesale abuse of the operation of curettage and brings discredit on the profession. A curettage, if done at all, must be done most carefully and aseptically, and to take as a general rule that it should be performed for all sterile women will be fatal to the chance of curing them. Too often have patients consulted me who have been made absolutely sterile by a badly done curettage. If any gynecological operation is being performed for the cure of the sterile woman, and she suffers from endometritis, curettage should be done. If she has no such symptoms curettage is incorrect treatment and lessens any chance of pregnancy which may be present. Dilatation of the cervix is done in all cases requiring operation.

Tumors of the uterus may cause sterility and a myoma is found as a common causal factor. Young (39) in an investigation on this subject, determined that the percentage sterility rate of women with fibroids was 31 against 10 in ordinary women. The cause of myoma is not known, but the well-established fact that this tumor is usually found in sterile women leads me to agree with those who consider that the tumor, in some cases, takes the place of the fœtus; that it is the unused energy of the uterus. The one form of treatment for the sterile woman is myomectomy. As will be seen later many cases have been cured. These were not cases of single tumor. In some of them a part of the uterus in addition to the tumor was removed. It is sometimes difficult to prognosticate about fibroids before operation, for sometines a woman who is anxious for children has a fibroid uterus which it is impossible to leave *in situ* and the patient should be warned and permission should be obtained that hysterectomy is to be practised if necessary. Some writers have spoken of the dangers of the rupture of the scar in subsequent pregnancies. There is no danger of this accident. The best technique for myomectomy is to introduce one or two tension sutures of silk in addition to the ordinary catgut. It is seldom that the pedunculated myoma causes sterility. It is far more common to find the interstitial or submucous type. Sterility is a definite contra-indication to the use of X-rays as a treatment for myoma.

Displacements of the uterus rank with tubal inflammation as a most common cause. Backward displacement with or without adhesions and other complications is most frequently encountered. Women may become pregnant who have backward displacement; but when sterility is present and there is a retroversion the latter may be certainly looked upon as the cause of the former. I was consulted recently by a girl about to marry. She wished examination under anæsthesia to determine her chances of conceiving. Everything was normal except for a backward displacement. The views outlined above were explained, she asked for operation and she was wise. In dealing with a sterile woman who has a mobile backward displacement there are two treatments to consider: the pessary treatment and the operative. Although strongly in favor of the latter, the former is useful in certain cases. Pessary treatment, if practised at all, should not be persisted in for more than three months; there is an ever present danger of sepsis spreading upward to the fallopian tubes, and it is much better on account of this danger to operate immediately. I do not intend to delve deeply into a discussion as to the most suitable operation. Alexander Adams' operation should be studiously avoided although Hayd (11) recommends it, even for sterile women. The abdomen must be opened so that the state of the tubes, ovaries, and other pelvic contents may be examined. Generally I

practise a modified Gilliam operation in which, after the abdomen is opened by a mesial incision, a curved forceps is guided underneath the aponeurosis of the rectus muscle to the internal abdominal ring and thence to a stitch which has already been placed on the round ligament, 1 to 1.5 inches from its uterine end. The ligament is then drawn through and sewed with No. 3 silk, to the under surface of the rectal aponeurosis at its outer margin. Thus the uterus is secured extraperitoneally and there is no danger of intestinal obstruction. The results, both symptomatic and in pregnancy and labor, are excellent. If the ligaments are not strong, ventral suspension is done. The Gilliam modification is preferred on account of the weight of feeling in the profession against ventral suspension. I have attended many women in confinement after ventral suspension without any untoward result. The prognosis in this type of case is extremely good.

While mobile displacement is found in connection with sterility, it is far more common to find a uterus fixed by adhesions and associated with tubal disease. When this is the case, palliative treatment is strictly taboo, and it is difficult to believe that sterile women with retroverted uteri fixed by adhesions are still being treated by such temporizing measures as tampons of ichthyol in glycerine, rectal massage, etc. There is no possible excuse for such treatment. While palliative measures may loosen adhesions to an extent sufficient to replace the uterus, they cannot open tubes; therefore, the only treatment is operation. As this operative manœuver entails a consideration of the fallopian tubes, the ovaries, and broad ligaments generally, it is well to consider these organs at this point in the paper.

Abnormalities of the fallopian tubes may be regarded as the chief cause of sterility, a view which is shared by Goullioud (9) and many others. Tumors and displacements of the tube need not be considered. Salpingitis may be taken as the only pathological condition to be reckoned with. This salpingitis may occur in many ways. Sometimes it may assume the dimensions of a large tubercular pyosalpinx. Brown Miller (22) states that such a condition produces a sterility which is often incurable. It may assume various degrees from a normal sized tube with closed ostia to a large hydrosalpinx or a tube with nodular inflammatory areas. Kinks are not limited to the intestine and Arbuthnot Lane. Gynecologists may have kinks and these are present in the tube. Some investigators among them, Tweedy (37), have suggested an excessively long tube as a possible cause of sterility and Opitz (26) refers to excessive length as predisposing to tubal pregnancy. I am not prepared, on finding a lengthy tube, to resect it.

It is sometimes difficult to conjecture the origin of the salpingitis which causes sterility. Gonorrhœa is probably first as an etiological factor, and it is of interest to note that Schaeffer (34) reports that in 451 cases of sterility gonorrhœa was traced in 67.3 per cent. Faulty technique may be reckoned as a good second factor, and under this heading may be mentioned the palliative treatments already condemned. It has, however, often been found on opening the abdomen that tubal diseases existed to a marked degree where curettage had been performed. I believe that septic instruments may be deemed to be prime offenders. It is astonishing to say that in my practice recently I met an unfortunate woman who had submitted three times to the operation of dilatation and curettage for the cure of sterility and who had marked salpingitis and abdominal adhesions! Tuberculosis of the tube is of very frequent occurrence.

The technique of operative treatment of retroversion of the uterus complicated by adhesions or adnexal trouble is as follows:

When the abdomen is opened the uterus is drawn up by a uterine forceps, or by a stitch. All adhesions are separated from below up. Those that can be done digitally are manipulated in this manner; in others where the intestines are adherent the adhesions are separated with a curved blunt pointed pair of scissors, taking care to avoid the gut wall. Raw surfaces are oversewn. The tubes are next examined and a decision come to as to the necessary measures to ensure at least one working tube and ovary on the same side. The tube is gently drawn upward and is held in a wipe: no heavy forceps are placed on it. If

there is nothing wrong, the tube is blown up by means of a sterilized ear syringe as a routine. If the ostium is closed it is opened. A smooth director is passed along to explore its patency. It is then blown up with the syringe, which process exposes all kinks. These are cut and the raw surfaces are oversewn at right angles to the tube with fine catgut. As recommended by Tweedy, catgut is next placed in the lumen. I use No. 4 catgut in the thickness of 8 strands when the ostium only is at fault. Tweedy and I reported one case each of tubal pregnancy following this routine, but since that I have had several cases of intra-uterine pregnancy. As, however, pregnancy has followed resection of the tubes without insertion of catgut, this is evidently not a *sine qua non* but it certainly is an improvement. When there is a constriction or a nodule in the isthmus, one is confronted with a difficulty. Is it better to remove the diseased portion and perform an end-to-end anastomosis or should the fimbriated extremity be removed as far as the diseased area? Young (40) has reported pregnancy following amputation of the outer halves of both fallopian tubes. Some writers have urged that the fimbriated extremity is necessary to successful conception. While agreeing to a certain extent, I am not in complete accord, for there have been several cases in my experience in which impregnation occurred after both fimbriæ had been removed. The question really lies between, first, removal of the fimbria, the new ostium being resected and catgut being placed in the lumen and passed by means of a long straight needle eye foremost into the uterus or, second, removal of the diseased portion, end-to-end anastomosis of the two ends and catgut being inserted at the resection, or the mesentery if the resected portion is first ligated. A long director is next threaded with catgut and brought to the cut surface. The catgut is next threaded on to a straight needle and is brought to the uterus as already described; it is necessary to change from the director to the needle owing to the diminished diameter of the uterine end of the tube. The end-to-end anastomosis is next concluded. After trying both of these methods the former is my choice, although in certain cases the latter method is preferable. I believe if the catgut is placed at the raw surface, it is not important whether it goes into the uterus or not. In my search through the literature I was amazed to find many ingenious methods which had been devised for catheterizing the tubes. Tyler Smith (35) in 1849 in a paper illustrated by figures, shows how he successfully catheterized the tubes by means of a hollow silver tube suitably curved at the distal end, the point of a whalebone instrument being then conveyed to the cornu. Madden (20) practised the same technique. Bullard (3) in an admirable paper of recent date shows some striking statistics following resection of the tubes. Gersung (6) has reported a case of removal of one tube and hydrosalpinx of the other which was cured and followed by pregnancy. Montana (23) has a pregnancy following double salpingostomy. Palmer Dudley (27) has 43 cases of pregnancy following plastic operations on the tubes, but he says he has only 2 from definite repairs. My statistics make me more hopeful about results. I do not intend, and I do not believe it enters within the scope of this paper, to discuss the peristaltic or cilia action of the tube and how conception occurs. I trust I may not be considered unscientific, old fashioned or pessimistic about the future when I say that I do not believe that the mysteries of birth and death are for us. Sometimes when the abdomen has been opened it is found that the uterus and adnexa are so diseased that nothing can be done.

When the examination and treatment of the tubes are concluded, the ovaries and broad ligament are examined and pathological abnormalities corrected. Ovaritis combined with salpingitis is often seen and is dealt with. It is seldom necessary to open the abdomen for ovarian trouble alone, though large one-sided papillomatous or adenomatous tumors are sometimes found in the sterile woman. It is, however, extremely common, having opened the abdomen for some other trouble to discover small cysts. In fact this condition is so commonly found that it may be looked upon as one of the signs of sterility, a fact with which Reynolds (32) agrees. If these cysts are present, the best treatment is removal. I am very slow to do complete

oophorectomy except in the case in which the tube of that side is beyond all repair. It has been stated by Kosmak (17) and Fallenberg (5) that removal of one ovary gives better function to the other. While this applies to the wholly diseased ovary, it does not apply to the women with ovaries containing cysts. It is certainly important to remove these small cysts. Whether they are associated with toughness of the ovarian stroma as suggested by Hedley (12) and in that respect allow the ovary to function better it is difficult to say, but good results follow resection. The small cysts which are often found in the broad ligament are removed. If displacement is present, a modified Gilliam operation is performed.

When the examination is completed, if nothing abnormal has been found in the pelvis, the general condition of the patient must be studied. Endocrinology is still in the experimental stage, and it is to be hoped that the reciprocal action of the thyroid and of the other ductless glands, with the genital organs will be thrashed out at an early date. The administration of glandular extracts when continued for a lengthy period and given in suitable cases meets with remarkably successful results. The most successful cases are those in which there is very little menstruation. Ovarian extract and dried corpus luteum (P. D.&Co.), especially the latter, give the best results. Fallenberg (5), in common with many others, has noted its good effects. A start is made with 5 grains daily and this is gradually increased until by the end of the month 30 grains are being taken in the day. The extract must be taken continually through the period and the treatment should be persisted in for one year. Often pregnancy results after 6 months. Even if the desired pregnancy does not occur, no harm is done, the general condition of the patient is improved, the menstruation is better in color and quality, and the uterus is slightly enlarged. To some the extract varium (B. W. & Co.) is given instead; at various times other glandular extracts and some mixed glandular preparations such as ovomammoid and hormotone are given. There is no doubt that ovarian extract is the best. The cost of these drugs is a grave disadvantage in the treatment of dispensary cases.

If the menstrual function is normal, if the pelvic organs are apparently normal, and if the man is normal, what can be advised? There is then only one rational procedure: dilatation of the cervical canal followed by laparotomy. At the laparotomy, if there is nothing abnormal, the tubes should be dilated. If there are such conditions as hydrosalpinx, broad ligament cysts, or other conditions mentioned already, they must be corrected.

The point I wish to emphasize most clearly is that if the patient is anæsthetized, the abdomen should in nearly all cases be opened. It does no harm. It means that everything possible has been done. I have dwelt already on the fact that closed ostia and other wellnigh undiagnosable conditions may be present. I quite appreciate that many women have become pregnant after a simple dilatation of the cervix, but the greater percentage who become pregnant when the abdomen is opened is an ample justification for laparotomy.

Appendicitis is a frequent association of sterility, but it is probably a precursor to salpingitis or it sets up adhesions and draws back the uterus. If the inflammation is found in the course of an operation for sterility, the offending organ is removed.

No definite mention has been made of venereal disease in this paper. I do not believe that venereal disease is nearly so commonly found as is believed. It is a pity indeed that syphilitides are not sterile, but it is a truism that syphilis shares with tuberculosis an unwanted fertility.

If a cure for sterility cannot be accomplished by any other means, direct insemination should be tried. It is a step which must and should be left until the last. The procedure adopted is as follows: Having been satisfied that there is nothing pathological in the pelvis of the woman and that the semen of the man is normal, the semen is collected in a condom and is injected into the uterus as soon after coition as possible. The patient is placed in the crossbed position; a vaginal douche of hot water containing sodium phosphate, one drachm to the pint is given, a Neugebauer's speculum is passed. The Braun's syringe

containing the semen is passed high up into the uterus and the fluid is injected. A tampon soaked in the remainder of the semen is then left pressed against the external os. There are not many cases in the literature; Rohleder (33) among others has reported some successful cases, and Lespinasse (19) speaks of insemination as a substitute for plastic operation on the cervix. I have not had a large experience of this treatment; in 17 cases there have been 6 successes. The time of election is from 3 to 5 days after the period.

Before coming to the concluding part of this paper which consists of my results, I would like to say that (1) one child sterility should be diagnosed and treated in the manner already mentioned for sterility; (2) contraceptives seem to cause sterility, a history of their use being given in many cases; (3) if all operations undertaken for the cure of sterility do not achieve their main object, at any rate they cure the abnormality for the correction of which the operation was undertaken.

With regard to my patients, in all cases the cervix was dilated except where this had been done previously. There were small cysts in the broad ligament in about half the cases. Kinks of the tube were present in many of the cases. These two conditions were so common that they were not always noted. The appendix was removed when it was pathological and where there were adhesions. In the cases of tubal resection catgut was inserted in the lumen.

Direct insemination cases and patients who became pregnant by treatment such as gland therapy without operation are not included in the list. As a routine after operation, ovarian extract is given to patients who have been suffering from scanty menstruation previous to operation.

The routine treatment of all patients was as has already been outlined in this paper. To the hospital patients who did not report themselves in person a letter containing the following questions was addressed and a stamped addressed envelope was enclosed.

1. How have you been since the operation?
2. Have you become pregnant?
3. If so was the confinement normal?
4. Give any further details.

The number of replies exceeded all expectations and this is to be attributed to the satisfaction experienced by those who had become pregnant and the desire for "something more to be done" by those who had not.

I have not included in this list cases which at the time of operation were found to have conditions which necessitated hysterectomy, or such other destructive operations which precluded any chance of pregnancy. The results in private practice are better than in hospital practice, for the reason probably that examination of the male is easier to obtain. The following typical case is sufficient. A woman seeks advice. Examination reveals the pelvis to be apparently normal. The woman is given this information; she asks if something cannot be done. In private practice the male is examined; in hospital, in this country it is impossible. Dilatation of the cervix and the fallopian tubes is performed in the case of the hospital patient. In the case of the private patient it is done after examination of the man. I have several times encountered cases where the husband had a chronic gleet—cases in which the woman was most anxious to be operated upon. These cases bring discredit on surgery in general and gynecological surgery in particular.

The following are my figures:

Letters written to hospital patients	302
Returned	13
Replied	281
No reply	8
To consider from above	281
Other patients communicated with by letter or otherwise	155
Total	436
Of these, became pregnant	205
Did not become pregnant	231
Percentage who became pregnant	47

The undermentioned was done for the patients who became pregnant: The same technique was carried out for those who did not become pregnant. The operation relieved the other symptoms of which they complained. Possibly in the case of some of those who did not become pregnant, the male was at fault.

Myomectomy (multiple)	9
Gilliam operation with dilatation of tubes with air—some complicated adhesions	59
Gilliam operation with resection of one ovary	30
Gilliam operation with removal of two ovaries	11
Gilliam operation with removal of one ovary	11
Resections of ovaries and dilatations of tubes	11
Ventral suspension with dilatation of tubes	7
Ventral suspension with resection of one ovary	2
Ventral suspension with resection of two ovaries	2
Ventral suspension with removal of one ovary	17
Gilliam operation and removal of one tube	12
Gilliam operation and resection of two tubes	4
Gilliam operation and resection of one tube	6
Dilatation and curettage of the former alone	9
Dilatation and Schroeder's partial operation	7
Circular amputation	5
Posterior division of the cervix	3
Total	205

Regarding bibliography, it will be noticed that the number of names is not large. In the literature the references are numerous. For a bibliography until the year 1913, I may refer the enquirer to the works of Huehner and Giles (7, 15).

CONCLUSIONS

The following are some of the conclusions arrived at from a consideration of the subject:

1. Sterility is a condition which at the present crisis of the population demands the serious attention of the profession. It is incumbent on the proper authorities to endow hospitals to a sufficient extent to allow thorough investigation to be carried out. Many women are denied admission to hospital through this lack of funds.

2. Sterility is curable in a large number of cases if care is taken to select the appropriate treatment. When operation is necessary, every minor point must be attended to.

3. When operation is determined on, the abdomen should be opened in nearly all cases.

4. The most common major abnormalities are backward displacement of the uterus and tubal inflammation.

5. The most common minor abnormalities are kinks of the tube, small cysts of the ovaries and broad ligament.

6. Dilatation of the cervix should be done in all cases requiring operation. Metal dilators should be used. Tents and pessaries which must remain in the uterus for some time should be avoided.

7. Even if sterility is not cured by operation the pathological conditions present are corrected.

8. There is no mortality.

9. The male should be examined when necessary.

10. Acid cervical secretion alone is not a common sign of sterility.

11. The administration of glandular extracts especially ovarian extract is useful in selected cases.

12. Finally, the statement must be reiterated that sometimes there is a definite physiological factor in conception, at present unexplained, which prevents conception.

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SAFETY FACTORS IN SURGERY WITH ESPECIAL REFERENCE TO THE BLOOD[1]

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MR. J. H. J., Case 19430, came under our care February 18, 1919, for an enlarged prostate with vesical calculus. The patient was semiconscious and unable to give his history. He was hiccoughing constantly. Physical examination showed the head, lungs, and heart negative; odor uræmic; the prostate enlarged. A searcher showed a stone in the bladder. The urine was ammoniacal; residual urine, 2 ounces; bladder capacity, 4 ounces. From his relatives was obtained the usual history of a gradually increasing prostatic disability. The systolic blood pressure was 180; diastolic, 135; pulse pressure, 45. Blood count: hæmoglobin, 90 per cent; erythrocytes, 4,640,000; leucocytes, 4,200; polynuclears, 71 per cent; lymphocytes, 28 per cent; eosinophiles, 1 per cent. Urinalysis showed albumin, triple phosphates, hyaline and granular casts, and rod-shaped motile organisms. The pulse varied from 100 to 130; temperature 98 to 99.2°F. Functional tests showed the following:

February 19, 1919. Phenolsulphonephthalein, first specimen (one hour), none; second specimen (two and one-half hours), 2 per cent; making a total of 2 per cent in two and one-half hours. Blood urea nitrogen, 136 milligrams per 100 cubic centimeters of blood; creatinin, 2 milligrams per 100 cubic centimeters of blood; blood urea, 291.04 milligrams per 100 cubic centimeters of blood.

February 25, 1919. Blood urea nitrogen, 88 milligrams per 100 cubic centimeters of blood; blood urea nitrogen, 188.32 milligrams per 100 cubic centimeters of blood; creatinin, 1.7 milligrams per 100 cubic centimeters of blood.

February 26, 1919. Under local anæsthesia (novocaine), a suprapubic cystostomy was done and a calculus removed. A Pezzer catheter was introduced. Bladder lavage was carried out.

March 3, 1919. Blood urea nitrogen, 57.7 milligrams per 100 cubic centimeters of blood; blood urea nitrogen, 123.478 milligrams per 100 cubic centimeters of blood; creatinin, 1.25 milligrams per 100 cubic centimeters of blood.

March 11, 1919. Blood urea nitrogen, 30 milligrams per 100 cubic centimeters of blood; blood urea, 64.2 milligrams per 100 cubic centimeters of blood; creatinin, 0.88 milligrams per 100 cubic centimeters of blood.

March 17, 1919. Blood urea nitrogen, 20 milligrams per 100 cubic centimeters of blood; blood urea, 42.8 milligrams per 100 cubic centimeters of blood; creatinin, 0.75 milligrams per 100 cubic centimeters of blood. Phenolsulphonephthalein showed a trace the first hour; second hour, 9.5 per cent.

March 24, 1919. A suprapubic prostatectomy was done under gas-oxygen anæsthesia. A Freyer tube was inserted and removed March 26. Irrigations were made daily. On March 29, the patient was up in a chair, he was eating well, his mind was clear, and the wound was rapidly closing. The pulse and temperature were normal. Recovery.

There must be some explanation for the fact that when two patients with similar conditions, as far as the usual examination is concerned, are operated upon by two surgeons of equal skill, or perhaps the same surgeon, one should recover and the other die There must also be some explanation for the fact that the man who is operated upon for appendicitis, on the kitchen table of his home, by his family physician, who has never before done an appendectomy, should make an uneventful recovery, while his neighbor dies after the same character of operation done by a noted surgeon in one of the city hospitals. Most certainly it was not the skill of one that saved his patient's life, nor was it the lack of skill of the other that was responsible for his patient's death; most assuredly one patient had a normal power of resistance through a normal metabolism and survived in spite of the operation, and the other with lowered resistance, the result of a disturbance of metabolism (which could probably have been foretold and the operation delayed), died in spite of the operation.

Since the discovery of Listerism, surgery has been busy perfecting a technique which has become so faultless as almost to preclude operative infection as a cause of death. Rubber gloves, aseptic ligatures, well trained operating room nurses and modern hospital accommodations have bred a school of "operators" which the laity and many of the profession fail to differentiate from, and daily confuse with surgeons. Until recently surgeons have been commendably occupied in unraveling pathologic problems as applied to the living and, as a necessary incident thereto, widening most extensively the domain of surgical therapeusis and, incidentally,

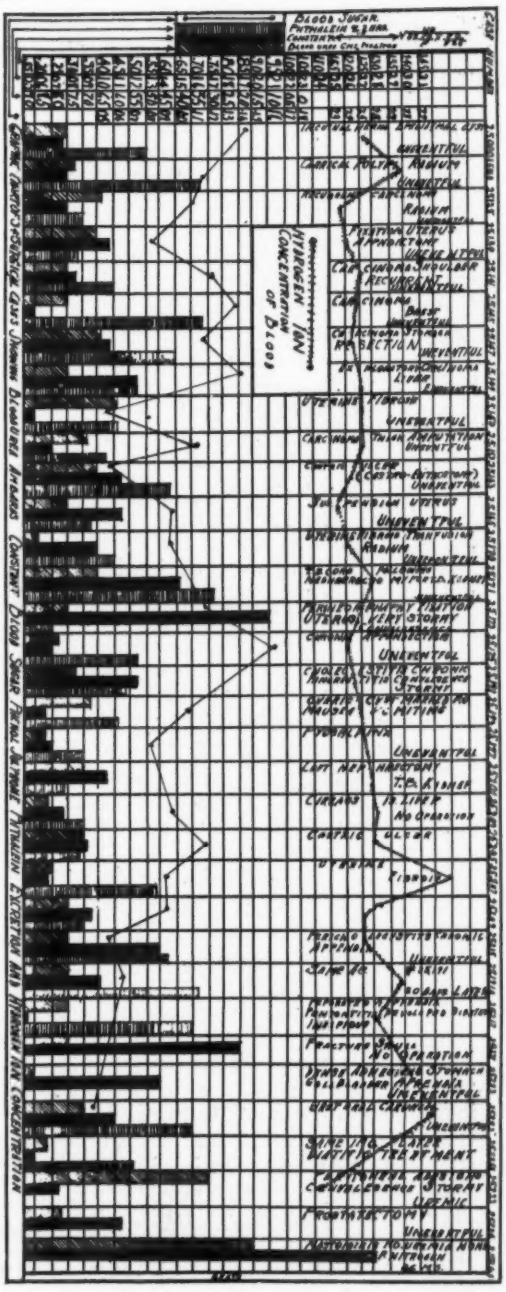
[1] Read before the American Association of Obstetricians and Gynecologists, Cincinnati, Ohio, September 15, 1919.

the opportunities for exploitation of the "operator."

We believe, however, that we are in the beginning of an era which will be marked by more careful and extensive study of the patient, not from the standpoint of making out a surgical lesion, but from the standpoint of his functional capacity to determine his exact resistance and thus ascertain a scientific evaluation of the operability of the individual. This will be an epoch of physiological surgery. The work of Crile, Henderson and others on shock, whether they are right or wrong; the work of Fischer and others, has opened a tremendously wide field for interesting and useful work. Stimulating the work of these men was and is the desire to reduce mortality, and as a consequence there has developed a wider and more extensive endeavor to estimate from the physiologic side the factors which play a part in producing death. In these endeavors we see the true surgeon, the internist, the physiologist, and the pathologist still working hand in hand.

The studies of Henderson and Fischer on acidosis, the investigations of Ambard and others on renal function, have enabled us to understand many factors we had not previously reckoned with, which play for or against recovery.

Despite the sphygmomanometer and sphygmograph, notwithstanding the "knocking at the door by opportunity" so clearly indicated in the work of Geraghty and Rowntree, until within the very last few years our preliminary estimate of operability has been most perfunctory and even more valueless. The examination consisted of an auscultory pulmonary and cardiac examination, a routine red and white blood count, and a urine analysis which concerned itself merely with the presence or absence of sugar and albumin and renal derivatives. These were done casually by an interne or mayhap an undergraduate nurse. How farcical, but oh! what importance we attached to them. Deaths we had, but then they were all from shock, immediate or delayed, maybe from iodoform poisoning, heart failure or some other cause satisfactory to us and easy of explanation to the family. It took our friends of the genito-



urinary specialty, led by Hugh Young, to awaken us to the importance of the work our confrères in physiological chemistry and in medicine were doing.

Recognizing the value of this careful preliminary study we believe that today we are able, barring the "uncontrollable accidents of surgery," to know fairly well what, always in competent hands, will be the probable outcome in any given surgical case. I say probable because we are still fallible in spite of our theoretic perfection of asepsis, of our knowledge of the burden the heart may carry, or of the work the kidneys will do.

The factors concerned in our study vary quite likely in each individual case and in some the preliminary study may be quite exhaustive, may even be repeated time and again along certain lines before the individual is deemed fitted successfully to undergo the operation. Again at times the operation may be done in more than one stage before the complete proposed procedure has been carried out, having in mind always the object of all surgical therapeutics, namely, a living, well patient rather than a brilliant operation and flowers

We will not dwell here upon the routine blood and urine examinations, nor upon the chest examination except to say that no patient with a "cold," however slight, is ever subjected to anæsthesia until all evidence of rhinitis, pharyngitis, or bronchitis has disappeared. Our routine microscopic blood examinations we look upon rather as diagnostic than as having bearing upon outcome.

An hæmaglobinæmia or marked anæmia would necessarily, except in a marked emergency, call for a postponement of operation until a more propitious finding, otherwise a direct transfusion of whole blood from a tested donor would be carried out just previous to operating. In such cases as in all individuals in whom transfusion is contemplated, the heart muscle must be carefully studied as to the burden it will carry. The weak heart muscle of the chronic anæmic may prove disastrous under a rapidly increasing blood volume.

So also, it is rather the poorly functionating heart rather than the organically diseased organ which we fear as an operative risk. Valvular heart lesions compensated for are not to be considered as bad risks but the low pulse pressure heart, the myocardium weakened, as shown by a dilatation or failure to do its work evenly and properly under exercise, is to be looked upon not as a possible but as a probable, dangerous factor. Practically all bad hearts manifest their deficiencies in the output of the kidneys. Therefore, a comprehensive study of the urine should be made. The output of solids as compared with the intake becomes of extraordinary importance to the surgeon, particularly from the standpoint of differentiation between heart and kidney disease.

Our genito-urinary friends taught us the necessity of estimating the functional ability of the kidneys, but there have been times when our simpler test, the phenolsulphonephthalein test, seems to have given us little or no information of any value. Our reliance upon this test alone led us not infrequently into error. So we turned to testing the blood to determine the kidney functionability from the standpoint of retention rather than continuing the urinary study from the excretory side. In this we also found we were at times misled in our interpretations. As a result we have within the past two and one half years made studies in our laboratory not only from the blood side, namely, of retention products, but conjointly of the output side.

We have no desire, nor is it our intention, to discuss the chemistry or physiology of the methods considered, but rather to give in a concise manner the results of the clinical application of our work in my own operative cases and to other cases which have come under observation for surgical relief and in which operative therapeusis was considered.

Many interesting facts were brought more sharply to our notice in our blood studies, and these seemed to bear out and prove to our satisfaction in a practical way the experimental work previously done by others. For instance a factor to be considered and which, we have learned to know, is not infrequently the cause of death, is that of acidosis. I am convinced that many of our septic appendicitis deaths, as well as those following gall-bladder

surgery and other types of work, ensue from acidosis rather than sepsis as they have generally been construed.

Henderson has shown that there must be certain buffer substances in the blood to prevent destruction of its alkalinity, in fact to maintain the blood at its normal alkalinity. This alkalinity is spoken of as the H-ion concentration, and is represented by a logarithmic notation of 7 which in the blood is very constant at 7.4. Variations in this concentration are of vastly more importance than temperature or pulse variations, and a variation of 0.2 in decrease means the very greatest danger to the patient. We know that individuals cannot live unless the blood be alkaline, and any finding below 7, our notation number, means at once acidity with dissolution if it has not previously occurred. A lessening of these buffer substances of the H-ion concentration, indicates an inability of the blood to carry the most abundantly produced of these acids, viz., carbonic acid, so that here is loss of respiratory stimulation, resulting in rapid diminution of lung ventilation and inability to establish the normal equilibrium of the blood.

It has been shown that the administration of ether causes a constant lowering of the carbonic dioxide capacity of the blood plasma and that the degree of diminution is proportional to the duration of the anæsthesia, the maximum being attained at the close of the anæsthetic, without change for, as a rule, a period of twenty-four hours. Herein we doubtless have the explanation of many deaths without recovery from anæsthetic, in which notwithstanding the postoperative treatment fatality ensues. What then is the remedy for this condition? The answer is careful blood examinations, the recognition of the lowered H-ion content, and the establishment of treatment previous to the administration of the anæsthetic.

Our tables studied in detail present quite a number of interesting points bearing upon the value of these safeguards, and our preoperative preparation with reference to diet, with reference to the anæsthetic, and the time for operation, has constantly in mind the chemical blood findings.

So, also, is the anæsthetic selected, keeping in mind the preceding facts and possibilities; and in our own work we have given the preference to gas-oxygen. Gas-oxygen does not lessen the alkaline reserve in the blood, produces no deleterious effects upon the kidney, does not materially alter blood pressure, and is by far the safest anæsthetic. Occasionally it is desirable that ether in very small quantities should be mixed with the gas oxygen, but under such circumstances ether is not given for its anæsthetic effect but as a stimulant. Under these circumstances and when given in this way it becomes the most valuable circulatory stimulant that we possess.

The anæsthetist is also a factor not to be overlooked. Gas oxygen may be and is exceedingly dangerous in the hands of those not trained in its use, and not thoroughly skilled. Ether in skilled hands is to be preferred to gas in those who have not the highest degree of efficiency in this particular mode of anæsthetic. The danger in the administration of ether is in carrying it to the point of saturation, as is done by many so-called skilled anæsthetists. Under such circumstances acidosis is not infrequently brought about, and ether anæsthesia becomes a source of the very greatest danger.

In not a few cases of abdominal surgery, the two stage operation may be a distinct advantage, and this is particularly true in certain types of supurating appendices, suppurative gall bladders, gastroduodenal ulcers, and in cancers involving various intra-abdominal organs. The greatest field of usefulness for the two stage procedures will probably be found in carcinoma of the stomach in those individuals who as a result of starvation have the narrowest margin between the normal alkaline condition of the blood and that of acidosis and in the prostatic with low kidney function and a high degree of nitrogen retention in the blood. There is nothing in the ordinary urinalysis to advise us of early metabolic changes or of early disturbances of renal function, and here again we must turn to our blood study in connection with extraordinary urinary analysis or study.

Formerly much dependence was placed upon the concentration of urea in the urine,

we know now that a lowering of concentration is often accompanied by an increased rate of excretion. In fact an increase in the quantity of urine may mean a deficiency in the concentrating power, especially for nitrogen (1). Whereas the normal kidney will secrete urine containing 1.5 per cent of nitrogen, the granular kidney may at best attain 0.6 or 0.7 per cent. Success then in freeing the body of its nitrogenous wastes is attained by an increase in the urine. In other words where the normal kidney will secrete 1,000 cubic centimeters of urine containing 15 grams of nitrogen, the diseased kidney will be compelled to secrete 2,500 cubic centimeters of urine with a 0.6 per cent concentration to rid the system of 15 grams of nitrogenous waste. It will, therefore, be seen that a lowering of urea concentration in the urine does not necessarily nor likely mean the retention of nitrogenous waste products in the system.

We are presenting in our chart a series of surgical cases in which the newer methods of determining metabolic disturbance and kidney function have been supplied. Under the medical cases are many that reported for some operative procedure, but upon examination were found to be unfit subjects, or suffered from some underlying disturbance that was more serious than the condition for which operation was sought.

It is a well known fact that a disturbance of renal function is a very common accompaniment of disease, particularly after the age of 50, and it is usually the degree of disturbance in the kidneys that makes a surgical procedure more or less hazardous.

Of the methods for investigating renal function, none probably have enjoyed the wide popularity of the phenolsulphonephthalein test of Rowntree and Geraghty (2). This method has been applied to a majority of *our* cases and generally speaking, shows a close agreement with other tests, but as will be shown, it is not infrequently misleading and in a few instances we believe that a new interpretation is needed for results obtained. We believe that this difference is due to the fact that we deal with the introduction of a foreign substance into the body and its elimination cannot always be compared to the elimination of natural waste products. We believe further that in a few instances it acts as a diuretic depending for this action upon renal irritation. We have no other way of accounting for a case in which, after the injection of the drug the two hour output of urine was 800 cubic centimeters and 93 per cent of the drug was excreted. The normal daily output of urine in the same individual was 1600 cubic centimeters. In other words, after the injection of the drug the first two hour quantity of the urine amounted to half the previous total 24 hour output.

The retention of nitrogenous products in the blood above certain figures (3) offers definite information concerning renal function provided we are familiar with the nitrogen intake. It has, however, a negative value under all circumstances. Studies of the urine and blood after the intake of fluid, salt and nitrogen has been carefully estimated (4), shows no definite relationship between the retention of these products and their increase in the blood. The retention of non-protein nitrogen, urea nitrogen, uric acid, sugar, creatinin, etc., have all been studied with the idea of determining renal function (3). In the study of any metabolic process it is always necessary to study three things: first, the food intake; second, the change which it undergoes in the body; third, the excretion of the waste products. A study of any one of these cannot give us very reliable information. Ambard (5) has followed this principle in his study of renal function by determining the maximal concentration power of the kidney. By comparing the concentration of the urea in the blood with the rate of excretion in the urine, the unknown factor is reduced to the rate of blood flow through the kidney and the functional activity of that organ. His laws briefly stated are as follows: First, the rate of urea output varies directly with the square of the concentration of urea in the blood, if the concentration in the urine remains constant. Second, the rate of excretion of urea varies inversely with the square root of the concentration of the urea in the urine, if the blood urea remains constant. The third law combines the first two and is the one generally in use for the determination of the constant. If

the concentration of the urea in the blood and urine varies simultaneously, then the rate of output varies directly as the square of the concentration of urea in the blood and inversely as the square root of that in the urine. By adding correction factors for the patient's weight and for a standard urinary concentration of 25 grams urea per liter of urine he obtained an accurate working formula.

Cathelin (6) opposes the adoption as being unreliable and Addis and Watanabe (7) have attempted to prove that the rate of urea excretion does not depend upon renal function. The work, however, of Lewis (8) and others seems to indicate that their contention is wrong. McLean (9) has substituted new figures for the original which he calls the index of urea excretion. The McLean index is not given in this series, but can easily be applied, if desired. The original co-efficient has been determined in all of the surgical cases in this series and with very few exceptions has been found reliable.

Acidosis, the cause of which has not been definitely determined other than that there is a general impoverishment of the body in bases or in substance which readily give rise to bases (10), has been determined by estimating the hydrogen-ion concentration of the blood (11). Other methods consist of examination of the urine, a study of the products of respiration and the amount of alkali necessary to render the urine alkaline when administered by mouth or intravenously. This latter method we believe to be as reliable as any and simpler of application.

The blood sugar has been estimated in most cases and a hyperglycæmia has been the reason for deferring an operation or for selection of a certain anæsthetic in a number of cases. Of the normal cases in this series, that is cases in which there was no suspicion of any disturbance of renal function, the average for Ambard's coefficient is 0.08, which agrees perfectly with McLean's (9) figures. The average blood sugar in 38 cases considered normal was 0.092 per cent which is in fairly close agreement with other observers.

For the phenolsulphonephthalein the average excretion in normal individuals was 60+ per cent. Our chart shows graphically the relationship existing between the blood urea, Ambard's constant, and the phenolsulphonephthalein excretion, hydrogen-ion concentration and the salt and nitrogen retention, where the nephritic test meal was given. Since this paper and chart show only the value of the various methods when clinically applied, no attempt will be made to account for differences shown in the various tests. Cases 25201, 25120, 25130, 25133 all show high coefficients with the normal or excessive phenolsulphonephthalein excretion. All showed clinically from the urinary analysis the evidence of impairment of renal function, except Case 25173 and in this instance convalescence following operation was very stormy, with pronounced uræmic symptoms. The phenolsulphonephthalein excretion in these cases would seem to be rather an unsafe guide, unless we look upon figures above 75 as indicating renal irritation and hyperpermeability and this we are inclined to do, particularly where there is other evidence that makes kidney permeability questionable. It might be contended that in these few cases the phenolsulphonephthalein excretion showed the true kidney function while the Ambard constant was faulty. To which we would reply that the other evidence from physical examination and the postoperative symptoms would indicate that the phenolsulphonephthalein excretion was not an index to the true functional capacity of the kidney. Attention has previously been called to such cases (13) and the belief expressed that there may be a stage in nephritis when hyperpermeability exists (14), at least, to phenolsulphonephthalein and some other substances. We have come to look upon an output of more than 75 per cent of the injected drug in two hours as being decidedly suggestive of renal disturbance with irritation where there is other evidence to indicate the same. Cases 25010, 25143, 25190 all have normal coefficients but with low phenolsulphonephthalein excretion, yet in all the convalescence was uneventful. It would seem from this limited number that a low phenolsulphonephthalein excretion is not always a contra-indication to surgery nor a true guide to the functional capacity of the kidney.

Case 25191 is rather interesting in this connection, showing an increased constant with an adequate phenolsuphonephthalein excretion at the time of operation Following operation convalescence was very stormy with symptoms of uræmia pronounced, and with improvement came a decided lowering of the coefficient but contrary to what would be expected a decrease in the output of phenolsulphonephthalein A discussion of the reason for this phenomenon is out of place here but the fact is significant. There seems to be no definite relation existing between the blood urea and the coefficient of Ambard. We would particularly call attention to Case 25733, which is an exception to the general rule and also to the law of excretion. Corresponding to the high blood urea content with a high urea constant was a high urea concentration in the urine and a greatly increased rate of output, thus making a normal constant of .077. This figure was misleading as a prognostic sign, since convalescence was very stormy and presented decided uræmic symptoms for a week or more. We believe that a high coefficient of Ambard deserves great consideration even in the presence of a normal blood urea but on the other hand we believe that a *high blood urea content* is extremely significant regardless of the constant or the phenolsulphonephthalein excretion. Such a combination will rarely occur however.

There is nothing of particular interest in regard to the blood sugar in these cases other than that in a few medical cases of Bright's disease, a disturbance of renal permeability for sugar is shown.

In concluding we would say that generally speaking there is a close agreement between blood urea, Ambard's constant and the phenolsulphonephthalein output. The few exceptions, as far as clinical results are concerned, would indicate that the coefficient of Ambard is a greater prognostic value than the phenolsulphonephthalein excretion, since in the several cases cited where the Ambard constant was normal and the phenolsulphonephthalein output was low, convalescence was uneventful and on the other hand with normal or increased excretion of phenolsulphonephthalein and increased constant, convalescence was usually more or less stormy. We would furthermore attach importance to a phenolsulphonephthalein excretion about 75 per cent, where there is further evidence of disturbed function. This is particularly true of tuberculous infection of the kidney.

A high urea content of the blood demands serious consideration regardless of other tests. In this connection it is well to mention the fact that Lewis (8) has demonstrated that in cases of nephritis with high blood ureas and high constant of Ambard, while the blood urea may be reduced to practically normal by careful diet, this decrease is accompanied usually by an increase in the coefficient, indicating no improvement as far as function is concerned.

CONCLUSIONS

From the numerous investigations concerning the condition of acidosis, renal function and the retention of protein products in the blood, all of which are determined for the purpose of ascertaining disturbances of metabolism, we are justified in drawing the following conclusions: A patient is not in the best possible condition to undergo any surgical procedure when he has—

1. A hydrogen ion concentration of his blood below pH 7.35.

2. A carbon-dioxide tension in the alveolar air below 35.

3. A soda tolerance test above 15.

4. An Ambard coefficient above 0.10.

5. A urine which shows but little variance in quantity from day to day and with the specific gravity varying less than 7 points regardless of the intake. Also nocturnal polyuria.

6. A phenolsulphonephthalein output below 40 unless it can be accounted for by disease of other organs, the liver particularly.

We feel that we can best conclude this article by quoting verbatim from Koshiro Nakagawa (15).

1. A normal constant does not necessarily imply freedom from disease but does indicate compensation of the renal defect.

2. An increased constant indicates impairment of function.

3. Particular diagnostic significance in tuberculous kidney: Normal constant suggests

only one kidney affected. Increased constant indicates both kidneys or that it is associated with toxic nephritis of opposed kidney.

4. In disease of lower genito-urinary tract an increased constant means impairment of renal function. This may be due to co-existent renal disease or to some obstructive or infective process in the lower urinary passage. In such cases, if the bladder is drained a few days before adopting more radical measures, and the constant approaches normal, it would indicate purely secondary disturbance of kidney, whereas if it remains constant it would mean a gross kidney lesion in connection with other pathology and points out the danger that may attend further operative measures.

5. Entails no discomfort to patient. Infection or ingestion of foreign substances is not required, nor is it necessary to control diet. It is applicable where ureteral catheterization or examination of lower passages is impossible.

6. Information as to state of renal function gained by urea in blood is amplified and completed by determination of Ambard's constant.

Methods Employed

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Non-protein nitrogen in the blood. Folin, J. Biol. Chem., 1912, lxi, No. 5. A combination of heat and air current was used for transferring the ammonia to the acid solution.

Uric acid in blood. Benedict's method. J. Biol. Chem., xx, No. 4.

Blood sugar. According to the Lewis and Benedict method as modified by Meyers and Bailey, J. Biol. Chem., 1916, xxiv, No. 2. In many instances both methods were used and checked against each other and the results were the same in every instance. The Meyers and Bailey method was then accepted and used throughout. A standard glucose solution was used in place of picramic acid solution, against which the unknown was compared.

Hydrogen-ion concentration of blood. Levy, Rowntree, and Marriott. Arch. Int. Med., 1915, xvi, No. 3.

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BILOCULAR (HOUR-GLASS) STOMACH

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BILOCULAR stomach is characterized by a mediogastric constriction like that of an hour-glass. The organ is thus divided into two pockets, an upper or cardiac pocket and a lower or pyloric pocket. These two pockets communicate with each other by an orifice or passage-way.

ETIOLOGY

The biloculation may be temporary or permanent. When temporary it is due to a spasm which momentarily constricts the stomach in the center. When permanent it may be due to a permanent spasm which occurs at the level of an ulcer in process of evolution or to the retractile cicatrix of an ulcer on the lesser curvature. The ulcer may provoke this mediogastric stenosis in several ways:

1. By spasm, an annular contraction of the surrounding layer of muscle at the level of the ulcer. An indentation is formed on the greater curvature opposite the ulcer of the lesser curvature.

2. By hypertrophy, an induration of the gastric walls. The ulcer becomes "callous," its edges are hard, or sometimes it is accompanied by perigastritis and becomes surrounded by cicatricial adhesions. The subserous and submucous thickenings become indurated, immobilizing the central portion of the organ between the two supple and contractile gastric pockets.

3. By cicatrization of the ulcer and fibrous retraction of the cicatrix, a retraction which involves the submucosa and the musculature.

We have operated by resection upon 23 cases of mediogastric stenosis which were not cancerous; in only four instances have we noted in the course of the operation that "healing" of the ulcer in the form of an annular, fibrous cicatrix between two gastric pockets with normal and supple walls. In 9 cases there was a non-cicatrized ulcer in the process of development. In 10 cases a perforating ulcer in the process of evolution had destroyed the stomach wall and penetrated into the neighboring organs, the liver, pancreas, and abdominal wall.

PATHOLOGIC ANATOMY

Mediogastric stricture. This is situated in the central portion of the lesser curvature, the usual site of ulcer. In fact, in 20 ulcers of the stomach, 19 were located on the lesser curvature. The ulcers called "pyloric" are either duodenal ulcers or ulcers of the lesser curvature which extend on to the pylorus or the walls of the stomach but always have their primary location on the lesser curvature.

The stricture has the form of an incomplete ring; the circle is broken at the greater curvature. Most often it is grooved and is several centimeters in length. The strictured channel is generally eccentric and near the lesser curvature. Toward the peritoneum the stenosis is indicated by a puckered cicatrix which is pearly white and may or may not be hidden by the lesions of perigastritis. In the majority of cases of mediogastric stricture we have found a perforating ulcer penetrating into the pancreas, the liver, or the anterior abdominal wall, and occasionally into two or three organs at once. In such cases operated upon by us there remained after the gastrectomy a complete pyloric pocket and a narrow ring coming from the cardiac pocket. This ring was joined to the lower pocket by a narrow band of healthy stomach tissue which represented the greater curvature. The stricture itself no longer existed and the intermediate zone between the two pockets was formed by the neighboring organs which had been invaded by the ulcer.

In the majority of these cases, therefore, the stricture is not formed by a true cicatrix but by fully developed perforating ulcers.

The cardiac pocket. The cardiac pocket is generally the most voluminous; it is volumin-

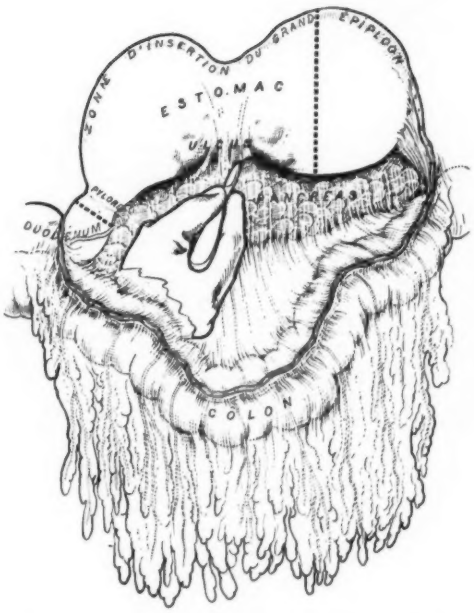

Fig. 1. Most often bilocular stomach is caused by a callous ulcer still in the process of evolution, sometimes perforating. Therefore it should be treated as an ordinary ulcer, that is to say, by hemigastrectomy. The stomach has been stripped of its omentum by means of a compress (Temoin). The dotted line represents the portion of the stomach which is to be resected (hemigastrectomy). The bistoury separates the ulcer and the pancreas.

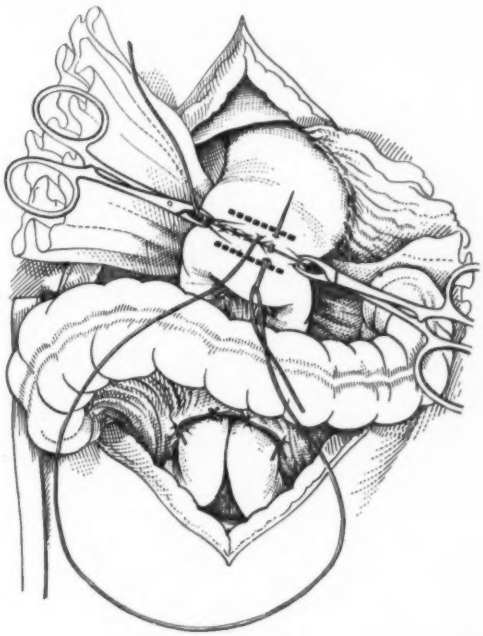

Fig. 2. Hemigastrectomy. Anastomosis of the upper pocket with the jejunal loop. Here as a result of the retraction of the upper pocket it is not possible to bring the gastric opening into contact with the gastrojejunal anastomosis. In order to close it, four sutures hold it to the jejunal loops.

The anastomosis unites the anterior wall of the stomach and the jejunum. It does not make any difference whether the anastomosis is done to the anterior or the posterior wall of the stomach. The choice should depend upon which can be done most easily. As the stomach then forms a cul-de-sac, one is sure that the anastomosis will be made at the lowest point by choosing the portion which can be drawn out most easily.

ous for two reasons; first, because the stricturing ulcer of the lesser curvature is nearer the pylorus than the cardia, and second, because the stasis of food has distended the upper pocket. The topography of the cardiac pocket is variable. In high position, the large tuberosity rises into the dome of the diaphragm above the cardia. In low position the greater curvature falls, dilates into a cul-de-sac, and is displaced toward the right, and in that case accentuates the stenosis. Occasionally we have found the cardiac and pyloric pockets of equal size; the stricture was then higher. In 4 cases the cardiac pocket was small and after gastric resection we experienced the greatest difficulty in implanting the end of the stomach into the jejunum.

The pyloric pocket. This is generally smaller than the cardiac pocket, but we have found it dilated in cases in which there was simultaneously a stenosis of the duodenum, a quite common complication.

Varieties. Beside the common form of hour-glass stomach described we have observed the following varieties: (a) mediogastric stenosis co-existent with duodenal stenosis; (b) stenosis accompanied by a perforating ulcer penetrating the abdominal wall, the liver, or the pancreas; (c) cancerous degeneration of a stenosing mediogastric ulcer; (d) perigastric abscess around a stenosing ulcer; (e) gastrocolic fistula in the strictured area.

SYMPTOMS

1. *Antecedents of gastric ulcer.* The classical syndrome of ulcer (vomiting, pain, hæmorrhage is exceptional. As has been shown by Mayo and Moynihan, gastric or duodenal ulcer is evidenced in the majority of cases by the painful phenomena of hyperpeptic gastritis (acid regurgitation); these disorders are decreased or aggravated by food; soothed by the bismuth régime. Their evolution is accompanied by remissions simulating cure, with periods of recrudescence. The longer the malady continues the shorter the remissions become and the greater the gastric distress. In fact, usually most of those who have gastric ulcer lead an ordinary life and are considered as "dyspeptics" or "neurasthenics," who are reconciled to their functional troubles.

2. *Painful phenomena.* The painful phenomena are due, not to the mediogastric strangulation, but to the chronic ulcer which has produced the stenosis. If the ulcer is perforating, it causes pain; often this pain is continuous throughout the day from the first meal and causes a paroxysm at each attempt to take food. Sharp epigastric and dorsal pain (*en broche*) is frequent and often accompanies perforating ulcer of the lesser curvature. These pains are variable and in the interval between the attacks are bearable. The vomiting does not relieve the pain. Food and diet relieve it slightly.

3. *Vomiting* is the rule; it is frequent, repeated, and due, not to the stenosis, but to the ulcer. If it occurs at intervals, is regular and copious, it is then due to the stenosis and represents the evacuation of the distended cardiac pocket. At first, the vomitus is mucous, but later it contains and continues to contain food; on the whole, this syndrome does not differ from that of ordinary pyloric stenosis.

4. *The general condition.* Emaciation, asthenia, and anæmia follow the hunger cachexia due to the stenosis, whether this stenosis is pyloric or mediogastric.

5. *The physical signs. A. Inspection and palpation* do not differentiate pyloric stenosis from mediogastric stenosis; distention, dilatation of the stomach, and peristaltic contraction appear at the moment of the pain as in stricture of the pylorus. The presence of a mass is due to a callous ulcer with perigastritis.

B. Examination with a sound. Intubation after fasting without lavage 12 hours after the last meal makes it possible to evacuate food residue as in cases of pyloric stenosis.

C. Intubation with lavage of the stomach reveals the following three phenomena which are of value chiefly from the point of view of diagnosis: (a) The lavage water returns only in part as it has passed into the pyloric pocket beyond reach of the evacuating tube. (b) Lavage is being accomplished normally and the liquid is returning as it entered when suddenly a cloudy fluid is obtained which contains particles of food; these come from the pyloric, pocket the contents of which have re-flowed through the mediogastric orifice. (c) The stomach is washed and well emptied by the sound; percussion still elicits a splashing sound the location of which is in the pyloric pocket which has not been emptied and which alone gives forth this sound

D. Insufflation of the stomach. When the stomach is distended two different results are observed. The entire stomach becomes filled with air; its outline can be made out by percussion or inspection in the form of two sonorous zones separated by a band of dullness (Gaston Lion).

Only the cardiac pocket is filled and becomes sonorous in the left hypogastrium; the lower pocket remains dull and gives forth a splashing sound (Bouveret). By the splashing sound it is possible to determine the lower limit of the stomach. The test should be repeated a few minutes later. In one minute the condition may change; the cardiac pocket is less distended and the pyloric pocket is sonorous; the air has passed through the stenosis, making a gurgling sound in rhythm with the respiration.

E. Radioscopy gives valuable information; it should be used 12 hours after a bismuth meal. The normal stomach viewed from the front has the form of the letter J; its upper portion forms clear lines separated by the opaque contents; a few spoonfuls of fluid are sufficient to fill it in the vertical direction; it then does not dilate except in a vertical direction and maintains its regular caliber.

The bilocular stomach has a characteristic appearance; sometimes this consists of two dark images united by a dark narrow band; this is a shadow in two parts which are disposed on a vertical axis or, rather, an axis that is slightly oblique, downward and to the right; sometimes there are two distinct shadows, an upper one on the left side in the form of a cone with an air chamber, and the other, a lower one to the right which is separated from the first one by a gap. This second pocket forms a segment of a circle with its convexity downward; it does not have an air chamber during the filling of the stomach. The pyloric pocket does not cast a shadow until several minutes after that of the cardiac pocket. Under the pressure of the finger the two gastric pockets are movable with reference to each other. The shadow never resumes the form of the normal stomach when the base of the organ is raised. It is impossible to empty the cardiac pocket into the pyloric pocket or to cause the liquid to flow back from the pyloric pocket toward the cardiac pocket. Often a diverticular formation is observed in the lesser curvature. This represents a perforating ulcer which is being filled with bismuth.

The true bilocular stomach should not be confused with the bilocular image of the ptotic stomach. The latter is characterized by the manner in which it fills. While the normal stomach becomes enlarged gradually as it is filled and its upper level remains constant, the ptotic stomach becomes filled like an inert sac; its breadth in the dependent portion reaches its maximum at once; its upper level gradually rises as the liquid is swallowed; the stomach becomes elongated under the weight of the fluid and as a result of this weight, it becomes strangulated in the center and thus resembles a bilocular stomach.

Neither should the true bilocular stomach be confused with the mediogastric spasm which causes a bilocular image but an image which changes or disappears in the course of repeated examinations or under the influence of atropine. Certain spasms are tenacious and persistent even when studied at several examinations; these unyielding spasms are then due to an organic cause and occur in the presence of a chronic ulcer; but if it is a case of a bilocular image due to mediogastric stenosis or a permanent spasm in the presence of a chronic ulcer, the error is not of much importance since the treatment of an ulcer in the process of evolution is the same as that of an established stenosis.

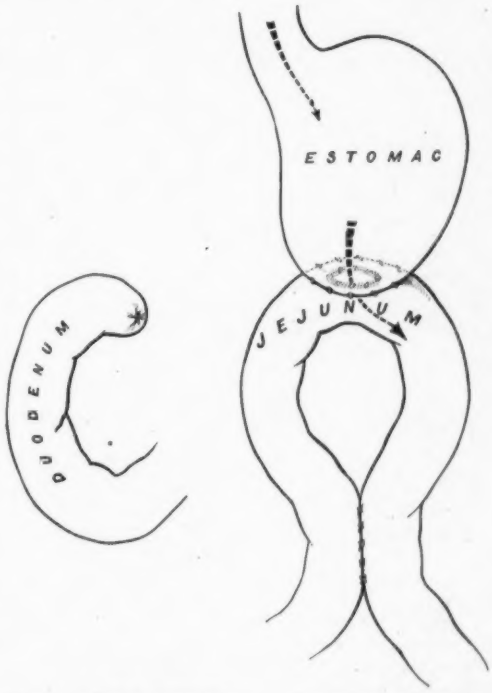

Fig. 3. Hemigastrectomy. Gastro-enterostomy. The gastric pocket is retracted; the jejunum has formed an angle at the level of the anastomosis and it has appeared advisable to the surgeon to do a jejunojejunostomy which permits the passage of the biliary and pancreatic fluids into the efferent loop.

SURGICAL TREATMENT

We reject gastroplasty and gastro-enterostomy; these two operations have given us good immediate results but have been followed by conditions which necessitated new interventions. On the basis of my personal experience, these two operations should be rejected.

Three operations are being advised: gastro-enterostomy, mediogastric resection; and pylorogastrectomy.

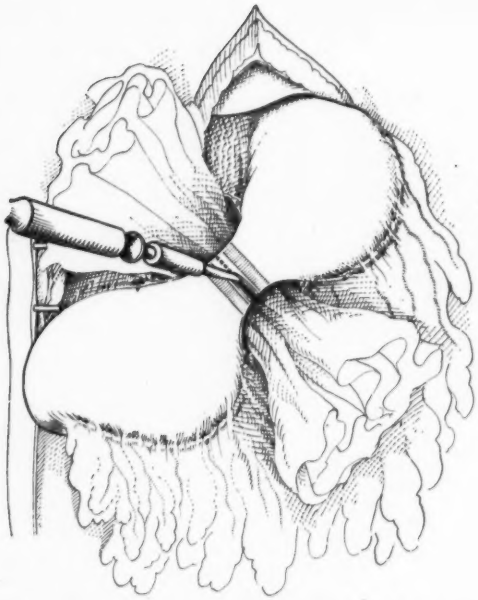

Fig. 4. Division and gastro-enterostomy. Narrow stenosis; ulcer completely cicatrized; an unusual but very favorable case. The ecraseur has crushed the retracted portion of the stomach as far as the healthy walls. The cautery is sectioning the crushed portion which is to be closed with a purse-string suture.

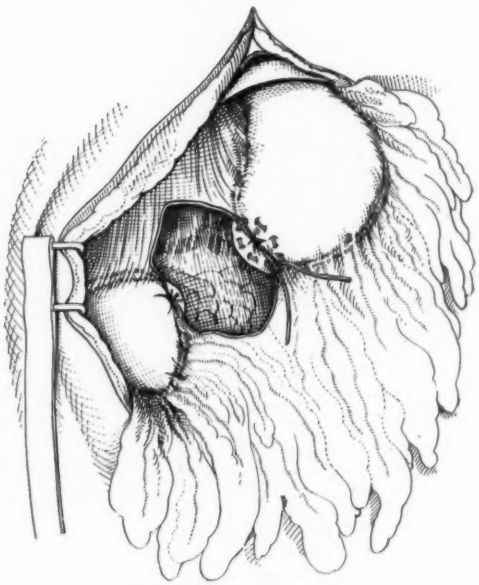

Fig. 5. Crushing and gastrojejunostomy. Closure of the two ends with a purse-string suture and gastrojejunostomy. The lower pocket remains.

Gastro-enterostomy. The surgeon makes an anastomosis between the upper pocket and the jejunum as if it were a case of stenosis of the pylorus. Very often because of the high position of the upper pocket the anastomosis forms a "kink" in the afferent intestinal loop and drainage is retarded. If, therefore, there is a "kink" the surgeon completes the gastro-enterostomy by a jejunojejunostomy. Often the ulcer continues to develop in spite of the anastomosis and again causes trouble. The surgeon is then forced to do a secondary gastrectomy. Why should not this pylorogastrectomy be done immediately? Because in some instances the patient is cachectic; it is necessary to do the operation in two stages, beginning with a gastro-enterostomy and performing a gastrectomy six weeks later. The patient stands the secondary resection very well and becomes definitely cured.

Mediogastric resection. To resect the strictured gastric segment or the gastric segment which has indurated walls. Annular resection of a portion measuring two or three inches is sometimes sufficient but more often it is necessary to sacrifice a greater area of the stomach. To accomplish such a resection the best procedure is as follows: Holding the stomach with the left hand, the surgeon wipes the greater curvature forcibly with a compress in the right hand to strip it of the greater omentum. He then strips the lesser curvature in the same manner. In this way he frees a strictured segment of the stomach which is ulcerated or perforated and completely stripped of its two omental coats and well isolated from the supple portion of the two gastric pockets. The diseased zone is crushed and resected.

How should the two healthy extremities of the stomach be treated? Close the two gastric ends with a purse-string suture and finish by making an anastomosis of the upper pocket and the jejunum.

Pylorogastrectomy or hemigastrectomy. This is the operation of choice. It consists in liberating the stomach on its two curvatures

by stripping with a compress. This stripping is continued as far as the duodenum which will be crushed with a Mayo, Gudin, or Thierry de Martel ecraseur and closed with a purse-string suture. The liberation is continued toward the cardia; the surgeon proceeds as far as the upper pocket which will be freed for a distance of several centimeters and closed with a purse string suture; a gastro-enterostomy re-establishes continuity.

If this upper pocket is small, side-to-side anastomosis with suture is impossible; the surgeon will then be able to choose between two procedures: either to leave the end of the stomach open and implant it directly into the jejunum in order to save several centimeters of stomach; or to insert one-half of a Murphy button in the upper end of the stomach and close it with a puckering suture; insert the other half of the button in the jejunum and close it also with a puckering suture. By an opening made with the cautery form a gastro-enterostomy.

These two procedures are good.

I had the opportunity to operate upon 25 and to resect 23 bilocular stomachs. These operations were divided as follows: 1 gastroplasty; 2 gastrogastrostomies; either alone or associated with a gastro-enterostomy; 4 mediogastric resections; and 18 pylorogastrectomies. I have re-operated upon two patients upon whom a pyloroplasty, gastrogastrostomy, and gastro-enterostomy had been performed. These patients were obliged to submit to a secondary gastrectomy for functional trouble. These operations resulted in two deaths; one case was complicated by a perigastric abscess and in the other there was an extensive perforating ulcer.

These operations were performed under regional or spinal anæsthesia with or without several whiffs of nitrous oxide for several seconds.

The extensive resections have given by far the best end-results.

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BONE CHANGES IN WAR AMPUTATION STUMPS*

BY THOMAS G. ORR, M.D., KANSAS CITY
Major, Medical Corps, U. S. A.

THE X-ray has shown some very interesting and unusual bone changes in the stumps of war amputations. These changes have been mainly due to the method of amputation so much used at the front. A very large percentage of the cases was done by the "guillotine" or flapless[1] method. A somewhat smaller percentage was done with flaps which were not sutured primarily but were often packed open or stitched back on the stump to facilitate drainage. In all of these amputations the bone was exposed to injury and infection producing conditions that rarely occur in the average case in civil practice.

In a review of more than 400 roentgenograms, the principal changes observed were spur formation, formation of sequestra, proliferation of bone, periosteal thickening, and, in a great many cases, marked rarification. Of these the chief interest lies in the spur and sequestra formations.

Spurs may project from almost any portion of the bone end but are least common on the cut surface. In the thigh the most common location for these bony growths is on the inner surface near the end and projecting upward into the adductor muscle or toward the sheath of the femoral vessels. They also very frequently project from the linea aspera. In the lower leg there does not seem to be

[1] Orr. The guillotine amputation. Ann. Surg., 1919, lxix. 543.

* From the Orthopedic Service of the U. S. General Hospital No. 26, Fort Des Moines Iowa.

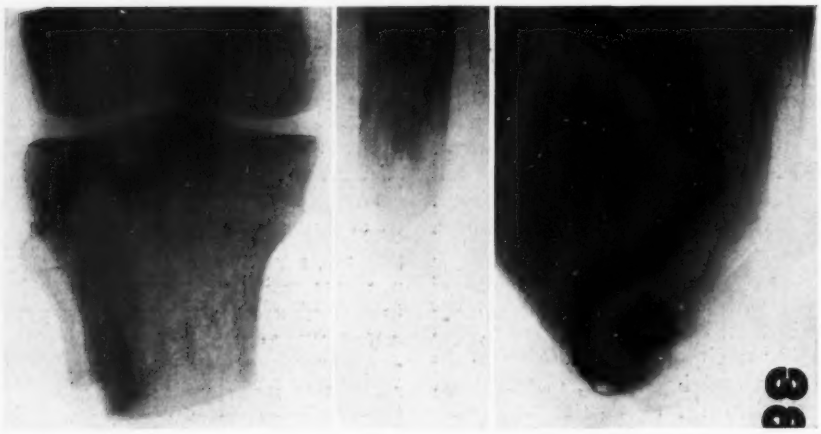


Fig. 1. Fig. 2. Fig. 3.

Fig. 1. Smooth healing of stump without bony change.
Fig. 2. Arm stump showing marked rarification of bone from prolonged disuse. Healed without infection.
Fig. 3. Shows convex shell of bone that sometimes covers the medulla during healing.

any particular location for their formation. This is also true of the upper extremity. They not infrequently follow sinus tracts leading from sequestra (Fig. 9).

Shredding or tearing of the periosteum and infection are probably the chief causes of spurs. In war amputations infection undoubtedly plays the chief rôle. Bone reacts

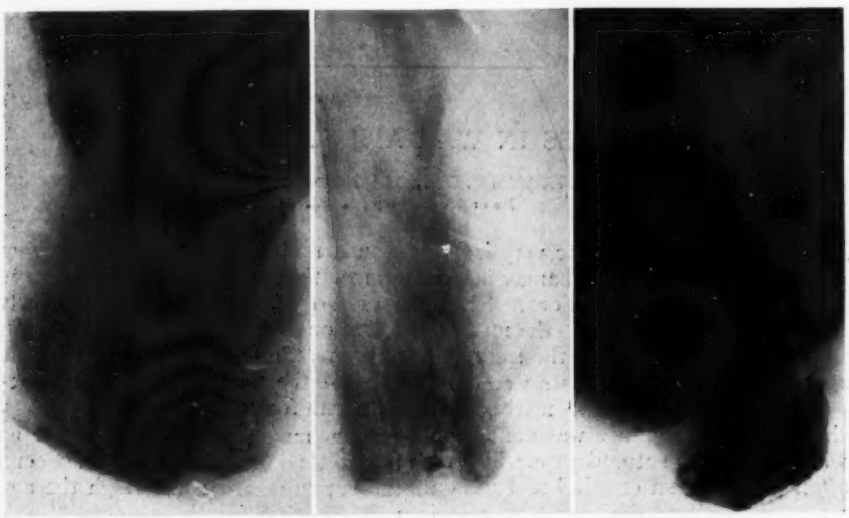


Fig. 4. Fig. 5. Fig. 6.

Fig. 4. Small spurs projecting from both tibia and fibula. This type of spur probably due to stripping up and shredding of periosteum.
Fig. 5. Ascending osteomyelitis of short femur stump. Note beginning sequestrum formation. Of 500 amputation cases this was the only example of so extensive an ascending infection.
Fig. 6. Lateral spur formation with marked retraction of muscle from the stump end.

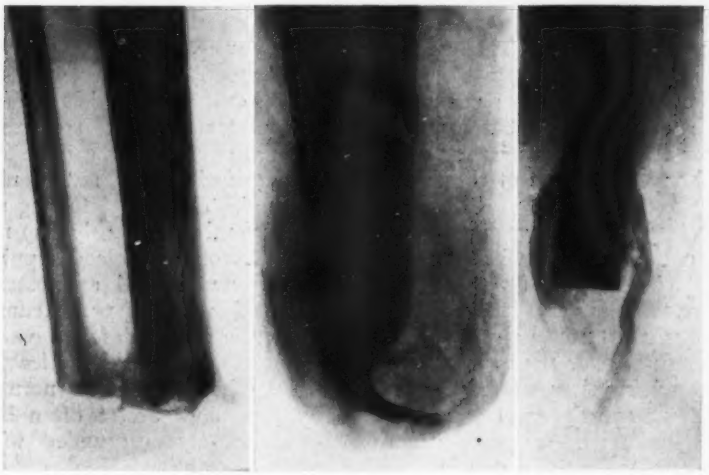


Fig. 7. Fig. 8. Fig. 9.

Fig. 7. Synostosis between tibia and fibula and tibial spur following "guillotine" amputation of the leg.

Fig. 8. Spur attached to the end of amputated tibia following an infected stump.

Fig. 9. The result of an infected arm stump. A sequestrum composed of the entire end of the bone has separated. Two slender spurs have grown along sinus tracts through redundant soft parts.

to infection in two ways that are directly opposed. The bone is either destroyed or it proliferates. It is very easy to see how torn periosteum could produce spurs like those in Figure 4 but not those in Figures 8, 9, 10, and 11. In the latter four cases infection exist-

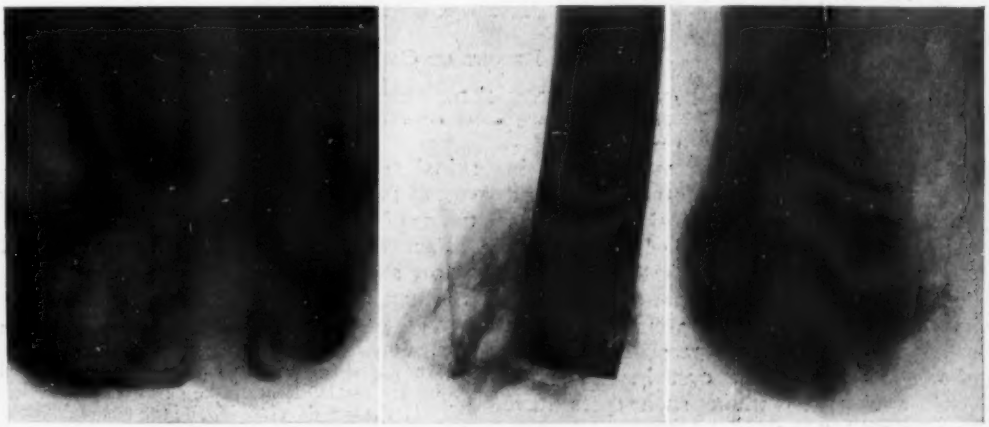


Fig. 10. Fig. 11. Fig. 12.

Fig. 10. Large spur extending into adductor intermuscular plane from a short femoral stump.

Fig. 11. Complete ring sequestrum separated from the end of a femoral stump. The fan-shaped spur formation extends into the adductor muscles. This spur was the result of an infected stump which followed a "guillotine" amputation.

Fig. 12. Complete ring sequestrum surrounded by new bone formation as result of infected "guillotine" amputation. Stump healed except small sinus from sequestrum.

ed for several weeks or months resulting in marked bone proliferation. The extensive spur shown in Figure 10, suggests the bone formation of myositis ossificans traumatica. These large spurs in the adductor region tend to follow the fascial planes very much as does the bony outgrowth of the familiar "rider's bone."

In a very large percentage of the cases spurs have not interfered with successful fitting of artificial limbs. If they are in a location where there is very little friction or pressure they will not cause any symptoms. Bursæ rapidly form over the spur ends permitting the overlying tissues to move freely. The presence of a spur, even of considerable size, is not an indication for operation unless it produces symptoms after a trial-fitting with an artificial limb.

Ascending infections of the bone following amputation have not been very common. In a series of 500 cases, there was but one with an ascending osteomyelitis (Fig. 5). In this case a thin shell of sequestrum formed which extended up the femoral shaft about 7 centimeters. This was removed and sound healing followed in a few weeks.

Sequestra are quite common in the open amputation. Here the bone is very apt to be deprived of its nutrition and become necrosed. The complete ring sequestra that so frequently occur (Fig. 11) may be due to the destruction of blood supply to the bone by the much used aperiosteal method of amputation. The periosteum and endosteum are removed for a varying distance from the end of the bone leaving it exposed to infection without its normal blood supply. Small sequestra often become almost or completely surrounded with new bone and may entirely heal over and remain healed for several months. Any irritation may light up an infection and form an abscess. This is one very important reason why all amputation stumps should be roentgenographed as a routine measure.

CYSTICERCUS RACEMOSUS (TÆNIA SOLIUM) INFECTION OF SPINAL CORD

With Report of Case

By A. R. KIMPTON, M.D., F.A.C.S., Boston
First Assistant Visiting Surgeon, Boston City Hospital

THERE occurred on my service, in the Boston City Hospital, referred from the neurological service of Philip Coombs Knapp, who had localized the tumor and requested that the patient be operated upon, an unusual and interesting case of cysticercus racemosus (tænia solium) which deserves recording because of the location of the cyst in the spinal cord, a situation where such cysts have been found but rarely.

I believe this case to be unique because of the extreme rarity of tænia solium in this country and because, so far as I know, it is the only case where a pork tapeworm has been removed successfully from the spinal cord during life. William H. Mercur, of Pittsburgh, I believe, found a similar tumor of the spinal cord, but at autopsy.

For the following, with pathological report and microphotographs, I am greatly indebted to F. B. Mallory:

Tænia solium is a tapeworm which occurs in man only. Its mature segments produce large numbers of ova which are voided in the fæces. Ingested frequently by the domestic hog, less often by other animals, the ova develop, invade the tissue and give rise to an intermediate form known as cysticercus. If incompletely cooked pork containing a cysticercus is ingested by man it will develop into a tapeworm, tænia solium, or by vomiting as a result of which ripened segments of the tapeworm or ova which have been discharged into the intestinal contents gain entrance into the stomach.

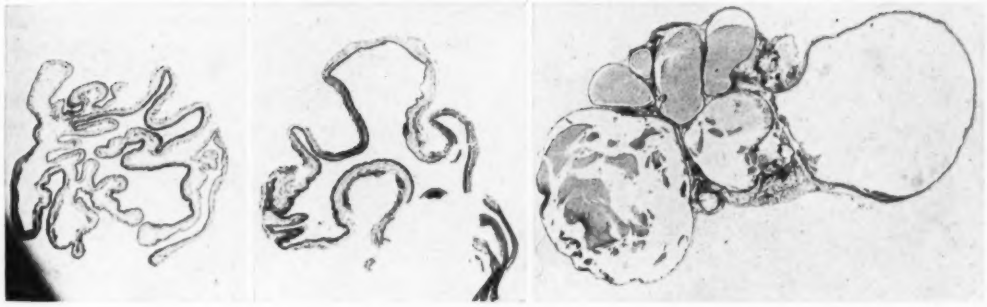


Fig. 1. Sections through three different parts of the specimen.

The tapeworm, tænia solium, ordinarily attains a length of 2 to 3 meters, but occasionally grows to be 6 or even 8 meters in length.

The cysticercus stage (cysticercus cellulosæ) as it lives in the intermuscular connective tissue and other tissues and organs of the domestic hog occurs as an elliptical vesicle 6 to 20 millimeters in length and 5 to 10 millimeters in diameter.

In man the cysticercus frequently occurs in the brain, where, owing to its irregular lobular shape, it is commonly called cysticercus racemosus. As many as 60 to 100 have been found in a single brain. They are very rarely found in the spinal cord.

Infection with tænia solium, or with its intermediate form, cysticercus cellulosæ, is rare in the United States.

The surgical specimen (S18.307), received at the laboratory consists of an elongated, thin-walled translucent cystic structure measuring 5.5 centimeters in length by 1 centimeter in greatest diameter. The upper end is formed by an oval cyst a little over 1 centimeter in greatest diameter. Joined to this is a second cyst a little smaller in size, in which 5 to 6 much smaller cysts can be seen. The rest of this specimen is a folded membrane 3.5 centimeters in length by 2 to 3 millimeters in diameter, which is evidently the wall of a collapsed cyst.

Microscopic examination shows the walls of the cysts to be composed apparently of connective tissue in which are numerous deeply staining (contractile?) fibrils. The cysts contain homogeneous or finely granular material: in some of the cysts it stains intensely with alum hæmatoxylin. The outer wall of some of the cysts is thrown into minute papillary projections and is lined apparently with minute cilia. Diagnosis: Cysticercus racemosus. (tænia solium.)

REPORT OF CASE

M. K., a Russian, male, age 25, was admitted February 1, 1918, to the Boston City Hospital Nerve Service of Philip Coombs Knapp.

Past history. Pain, constant and dull, began in both sides of his chest in the winter of 1916. Since then the pain was intermittent until January 20, 1918, when it became continual. Since October, 1917, his feet have been cold and numb, he could not walk straight, and he became tired easily. He had some weakness of legs and atrophy of left quadriceps.

Sensory symptoms. Anteriorly, hyperæsthesia and hyperalgesia from seventh intercostals downward to both feet, but more marked on the right. Posteriorly, the affected areas reach over the right side from the level of the ninth dorsal spinous process, and over the left side from the first lumbar spinous process toward the feet.

Reflexes. Arms normal. Absent epigastrics, abdominals, and cremasterics. Knee jerks lively. Double patellar clonus. Very lively Achilles jerks. Double Babinski. Moderate ataxia, most marked between heel and knee. *Knocking over fourth and fifth dorsal spinous processes with hammer causes pain; causes no pain over the remaining processes.* (Note location of tumor at operation.)

The patient was transferred to first surgical service with request by Dr. Knapp that he be operated upon, and with expectation of finding spinal cord tumor at fourth or fifth dorsal segment.

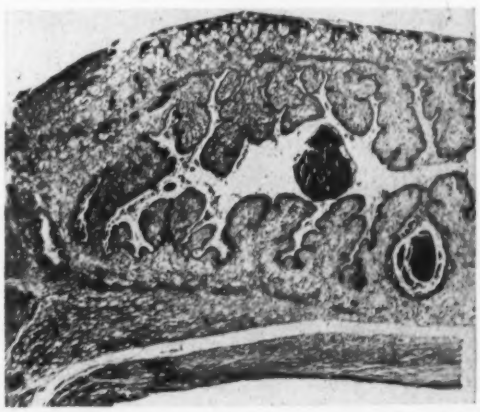


Fig. 2. The most solid part of the cysticercus.

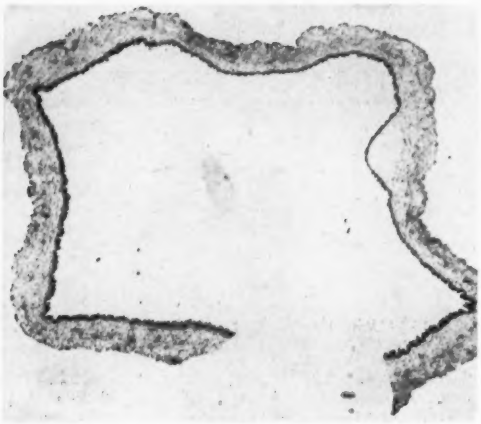


Fig. 3. The cyst wall turned inside out, showing the characteristic wavy external surface.

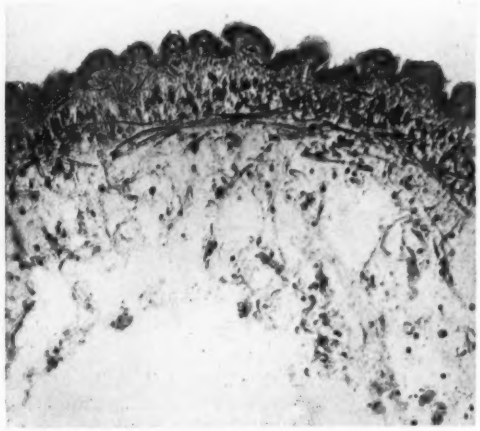


Fig. 4. High power view of cyst wall seen in Fig. 3, showing more perfectly the undulating external surface and the contractile fibrils in the underlying tissue.

Operation, March 6. There was nothing unusual about the technique of the operation, except that it was difficult because of the region. Laminectomy was done upon the fourth, fifth, and sixth dorsal vertebræ and the cord exposed. Between the fourth and fifth dorsal vertebræ there was a distinct difference in the tension of the cord. The tension appeared to be greater, and the cord was paler in this region. This was difficult to demonstrate to onlookers, but to the operator the difference in tension was very marked. The cord itself was now exposed and split longitudinally with a very small thin bladed knife. This revealed the translucent tumor described in the pathological report. With the little finger the tumor was easily shelled from the cord. It appeared as a gelatinous mass. Its gross appearance was entirely new to all who witnessed the operation and to myself, and no one had any idea of its nature until Dr. Mallory enlightened us. The membranes were now closed with the usual closure of a laminectomy wound.

Findings at examinations by Dr. Isador H. Coriat of the neurological service. March 9: Moderate priapism, no paralysis of diaphragm or respiratory muscles. All but a few upper abdominals absent. Cremasterics absent. Knee jerks diminished with slow reaction time, flaccid paralysis of both legs, right plantar reflex absent, slow Babinski on left, and complete loss of sensation below lower border of eleventh dorsal vertebra. May 14: Cremasterics returned. Knee jerks present and livelier on left. Achilles jerks present. Plantars very sluggish. Sensation reappeared on left outer calf. (Patient sent home.) July 30: At patient's home. (At this time the patient had shown a remarkable improvement both neurologically and as to his general condition.) The patient was on an air mattress. He was incontinent, although he could tell when he passed his urine. He could flex toes of his left foot. He had contracture of the Achilles tendon. Knee jerks normal. His right plantar reflex was absent, the left normal. Abdominals and cremasterics absent. He had *superficial small bed sores.* He could turn over in bed although he could not move his legs. There was analgesia and anæsthesia below twelfth dorsal segment. His general condition was much improved however.

A very short time after Dr. Coriat's visit to the patient at his home, he was readmitted to the first surgical service with extremely bad bed sores and a severe gastro-intestinal upset with great distention. This distention was relieved by enemata. He continually grew worse and died August 15, 1918. Unfortunately, autopsy could not be obtained.

Fig. A.

Fig. B.

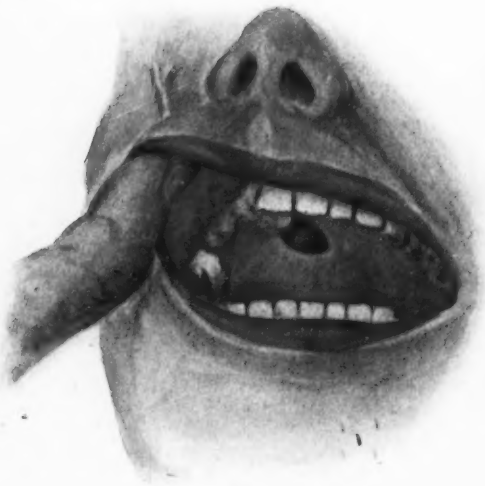


Fig. C.

Fig. D.

Fig. A. Case 1. Showing loss of substance of hard palate and aperture between oral and nasal cavities, from gunshot wound. The teeth and fragments of jaw, shown on the right, were separated from the rest of the jaw by the projectile. There is fibrous union with a faulty alignment of fragments. The dental appliance shown in the picture has been affixed for the purpose of restoring the alignment of the teeth and of diminishing the space between the teeth caused by the loss of teeth and displacement.

Fig. B. Final result in Case 1, 2 months after operation. The aperture has been entirely closed and the functional result is excellent.

Fig. C. Actual pathology in Case 2, showing loss of substance in hard palate from machine-gun bullet injury. Note also the absence of the upper right molar and bicuspid teeth, which were removed by the passage of the bullet.

Fig. D. Final result in Case 2, with complete obliteration of the aperture and excellent functional restoration.

Plate I. (*Plastic Repair of the Hard Palate for Loss of Substance from Gunshot Wound. Fred H. Albee.*)

DEPARTMENT OF TECHNIQUE

PLASTIC REPAIR OF THE HARD PALATE FOR LOSS OF SUBSTANCE FROM GUNSHOT WOUND

By Colonel FRED H. ALBEE, M.R.C., U.S.A.
Formerly Chief of Surgical Service, U. S. A. General Hospital No. 3, Colonia, N. J.

Loss of substance of the hard palate from congenital defect or from direct trauma, is not uncommon. In military experience, cases of gunshot injury to the hard palate, involving extensive loss of substance have been frequently encountered. The attendant difficulties of mastication in such cases, with the resulting ill-effects on the health of the patient, as well as the serious interference with his comfort and well-being through the acute consciousness of the impediment to enunciation, etc., emphasize the importance of repair of such a defect.

Fig. 1. Case 1. Drawing demonstrating position of the head of the patient over the end of the operating table, with the Connell-Y tube in place at *A* (see Fig. 2). Note the accessibility afforded, the good view of operating field and the ease with which the surgeon is able to work on the roof of the mouth and the palate when the patient is placed in this position.

In an experience with a wide variety of plastic cases, both at U. S. Army General Hospital No. 3, at Colonia, N. J., and in French military hospitals during 1916, none, perhaps, have presented results more interesting and gratifying to the author than two cases of restoration of loss of substance of the hard palate, which are herewith reported. The first case illustrates the use of a pedicle flap of mucous membrane and submucous tissues, secured from the inner side of the lip, in the repair of this defect, a method, which, so far as the author is aware, has never heretofore been employed. In this case, two teeth with the alveolar process had been shot away by the same bullet that destroyed a portion of the hard palate. The extensive scar and the large size of the aperture in the hard palate, remaining after the healing of the wound, made it necessary to secure material for the repair of this defect elsewhere than from the palate, itself. Through the cleft caused by the loss of the two teeth and the complete thickness of the alveolar process, a large plastic pedicle flap was drawn from the inner side of the lip, by means of which the aperture was closed.

It is believed that the technique followed in the foregoing instance is one that may well be

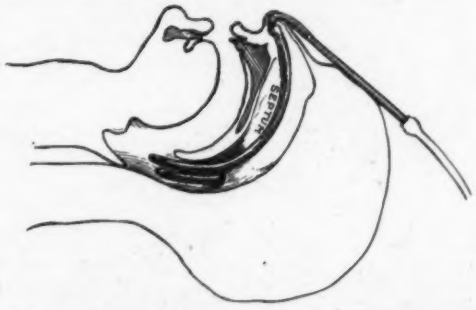


Fig. 2. Case 1. Sagittal section showing interior position of Connell-Y tube with catheters 12 centimeters in length.

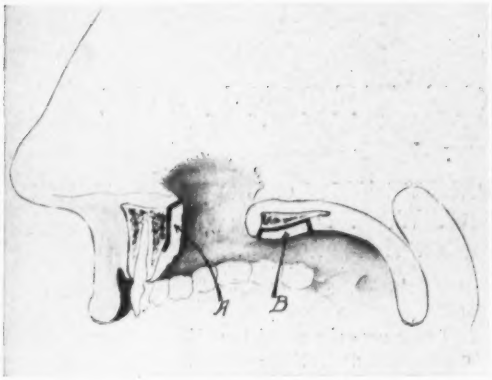


Fig. 3. Case 1. Diagram to demonstrate the plastic flaps *A* and *B*, before they are displaced to close the aperture.

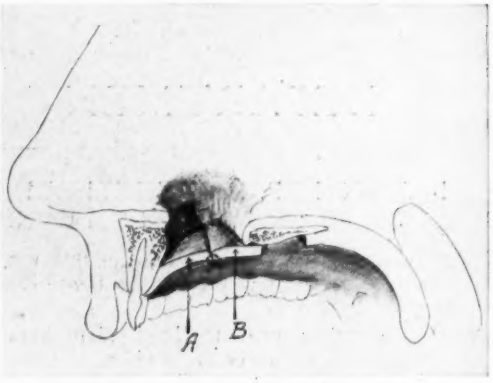


Fig. 4. Case 1. Showing the adjustment of the plastic flaps to close the aperture. Attention is directed to flap *A* which has been swung downward, hinge-like, and is now at right angles to its former position.

generalized and applied to all cases of extensive loss of substance of the hard palate, resulting from traumata, congenital defects, pathological conditions, etc., in which cases on account of lack of available tissues for the closing of large apertures, the above procedure of obtaining the plastic flap may be employed by the preliminary means of the extraction of one or two teeth and the removal of the alveolar process surrounding these teeth to a depth sufficient to permit of a cleft through which the pedicle flap may be drawn. In the case above cited it should be again emphasized that this had already been accomplished by the passage of the bullet.

In work of this nature, it is hardly necessary to call attention to the highly desirable character of the tissues comprising a pedicle flap taken from the inner side of the lip, the vascularity

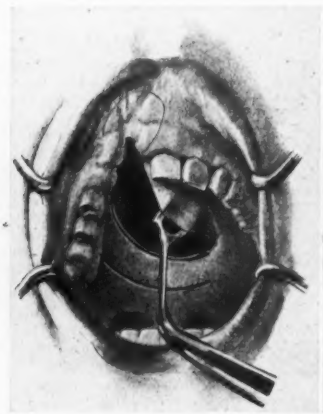


Fig. 5.

Fig. 6.

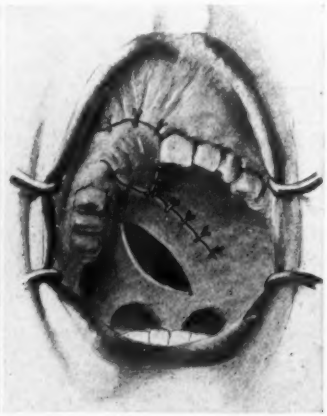


Fig. 7.

Fig. 5. Case 1. Showing the incisions made for the purpose of freshening the edges of the aperture and to form the plastic flaps. The technique of separating the flaps by means of the McBurney retractor, as described in the text is also indicated.

Fig. 6. Case 1. The aperture has been closed as far as is possible by means of the material available from the roof of the mouth. A circular incision is shown in the mucous membrane of the inner side of the lip, preliminary to the formation of a flap which is to close in the remainder of the aperture by being drawn through the cleft in the alveolar process, as described in the text.

Fig. 7. Case 1. Complete closure of the aperture, demonstrating flaps and sutures in place.

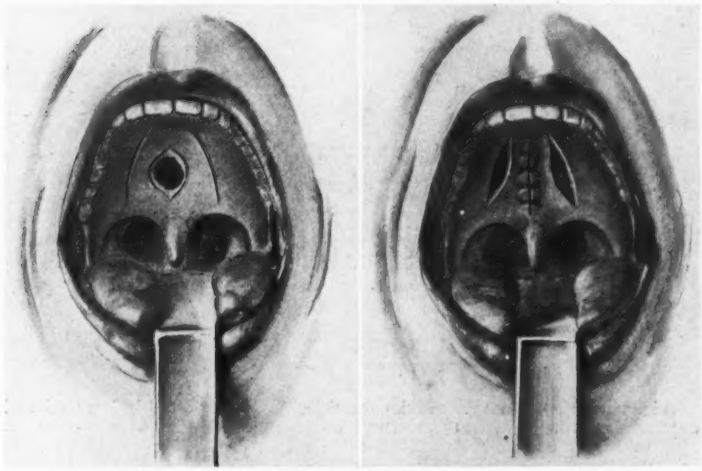


Fig. 8 (at left). Case 2. Showing the incisions made to freshen the edges of the aperture, as well as to form plastic flaps for its closure.

Fig. 9. Case 2. Showing the displacement of the flaps with the closure of the aperture and placement of the silk sutures.

of tissues of this region, or their remarkable plasticity. In all such cases, in which a large amount of scar tissue surrounds the aperture and an environment unfavorable to the growth of free transplants is presented, pedicle grafts from the lip seem definitely indicated. Moreover, where loss of substance is extensive, as in the case cited above, this technique is a necessity, since there is no other possible source of obtaining material.

On the other hand, in the second case of loss of substance of the hard palate, to be reported, the aperture resulting from the gunshot injury was not so large, nor was there so great an amount of scar tissue in the soft parts surrounding it. In this case it was possible, therefore, to secure sufficient material from the hard palate, itself, in restoring the loss of substance. Detailed reports of these cases follow:

CASE 1. B. H., age 21 years, Corporal, Co. K., 9th Inf., A. E. F., was injured on July 18, 1918, at Soissons, by a machine-gun bullet which, entering the right side of the face near the nose, destroyed in its passage a large portion of the hard palate and removed two teeth on the left side of the upper jaw, together with the adjacent alveolar process, causing a complete separation of the anterior portion of the upper jaw, from the posterior portions on each side. The patient was first removed to a French field hospital, where he was operated upon the following day, and thence to various hospitals in France for treatment, returning to the United States in December, 1918.

Upon admission to U. S. Army General Hospital No. 3, Colonia, N. J., on December 9, 1918, his wounds were entirely healed, but the jaw fragments were not in alignment and there was fibrous union. His general physical condition was good, although he was slightly under normal weight. Owing to the size of the aperture in the hard palate, much difficulty was experienced in masticating food, and in swallowing. It was also impossible for the patient to enunciate clearly and on account of an inability to control under pressure the passage of air in the oral cavity, he could neither expectorate, whistle nor blow his nose.

The patient was assigned to a convalescent ward for observation and for dental treatment in preparation for the final plastic repair. For 10 weeks he was under the care of the prosthetic dentist, who by means of the apparatus shown in Plate I, Fig. A, and by other orthodentia methods, slowly drew the island of teeth and the jaw fragment into general alignment with the remaining teeth and portion of the jaw.

Operation. On June 6, 1919, the plastic closure of the aperture in the hard palate was performed. The patient was placed upon the operating table in a dorsal position, with the head hanging over the end of the table in extreme hyperextension, the long axis of the head being approximately at right angles to the trunk, as shown in Figure 1. The jaws were separated by means of a mouth-gag, whereby a good view and a comfortable approach of the operating field were secured to the operator as he sat on a stool with the top of the patient's head hanging just above his lap, as shown in Figure 1.

Induction of anæsthesia was produced by means of ethyl chloride and drop ether, and was further maintained by intra-pharyngeal insufflation of ether vaporized with oxygen through a Connell-Y tube, as illustrated in Figures 1 and 2. By the use of the Connell-Y tube, the surgical stage of the anæsthesia was evenly maintained without interfering with the operation. To prevent the flowing back of excessive blood into the trachea and pharynx, a sponge, constantly renewed as it became saturated, was kept between the posterior part of the hard palate and the base of the tongue. This sponge also served

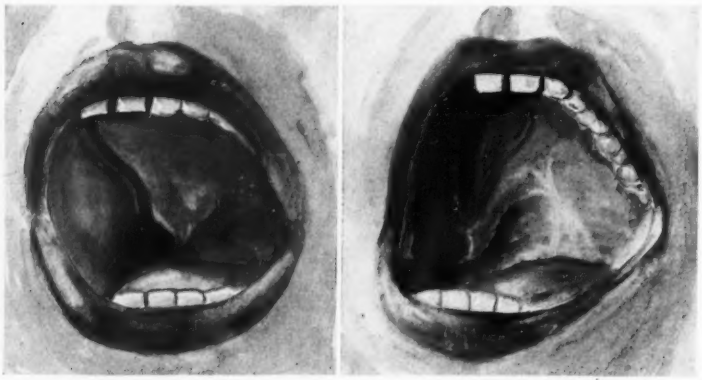


Fig. 10 (at left). Case 2. Showing carmichaels on both central incisor teeth and a gold shell crown on molar tooth, with a gold bar connecting. This appliance was attached by C. C. Prosser, D.D.S., for the purpose of furnishing a support for the rubber restoration, shown in Figure 11.

Fig. 11. Case 2. The missing teeth have been restored by a *removable rubber restoration*, which is affixed to the gold bar, shown in Figure 10, by Gilmore attachments. This very satisfactory work was also done by C. C. Prosser, D.D.S.

to prevent the escape of the anæsthetic from the pharynx through the mouth.

Great care was first taken to freshen the edges of the aperture by removing the scar tissue well into the healthy area, as illustrated in Figure 5. One-half inch back of the posterior portion of the aperture, a parallel circular cut was made completely through to the bone of the hard palate above (as is indicated in Figure 5), producing a strip of soft tissue of the hard palate for a flap, which is shown in this same figure, and also in Figure 3, *B*. On the anterior portion of the aperture, a cut was made producing a plastic flap, as shown in Figure 3, *A*.

Both plastic flaps, *A* and *B*, were separated from their bony attachments by means of the best instrument available, namely, a McBurney goiter retractor, which is shown in Figure 5. This instrument, by nature of its hoe-like characteristics, permitted these flaps to be easily separated from the bone. These plastic flaps were then brought into apposition by interrupted sutures of No. 4 braided silk, as indicated in Figure 4, *A* and *B*, and in Figure 6.

As noted in Figure 6, it was possible to close only about one-half of the aperture; the remaining half was very readily and satisfactorily filled by a swinging flap from the inner side of the lip, as is indicated by the circular incision in the mucous membrane in Figure 6. This flap was turned and twisted on its pedicle and used to cover the remaining portion of the aperture, in the manner shown in Figure 7. Very satisfactory primary union occurred in every portion of the wound, and the silk sutures were removed on the sixth day. Convalescence was uninterrupted in every particular.

Final results. At date of writing (August 18, 1919), about two months after operation, the results have been satisfactory in all respects, as shown in Plate I, Fig. B. The patient has experienced special gratification in the restoration of his lost functions as to ease in enunciation, mastication, etc.

CASE 2. E. T., age 29 years, Second Lieutenant, Co. 20, 5th Marines, A. E. F., while on duty at Château-Thierry on July 6, 1918, was struck by two machine-gun bullets: one entering just in front of the lobe of the left ear, passed forward and inward, becoming imbedded in the antrum of the right superior maxillary bone; the second bullet, entering the mouth, removed the bicuspid and molar teeth from the right upper jaw and made its exit just below the antrum. The patient was treated at various hospitals in France, returning to America in September, 1918.

Upon admission to U. S. A. General Hospital No. 3, Colonia, N. J., on September 9, 1918, his general condition was excellent. Examination of his war injuries showed fibrous ankylosis of the temporomandibular joint on the left side, as a result of the injury, and destruction of a portion of the hard palate and the temporal bone near the glenoid fossa. There was an aperture of ⅝x⅞ inches in diameter, in the hard palate, extending completely through from the oral cavity to the nares, as shown in Plate I, Fig. C.

The patient received treatment for necrosis of the right antrum of the superior maxilla, portions of necrotic bone being removed from the vomer and the hard palate. On November 15, under anæsthesia, roots of two teeth, upper molars, were removed, the alveolar process was curetted, and the fibrous ankylosed joint was stretched by forcing the jaws apart manually, and by means of a conical-shaped screw of hard rubber, known as the *rubber screw oral gag*, commonly used by the anæsthetist. The patient was instructed to use this screw himself daily. He was also given physio-therapeutic treatment, consisting of daily massage and forcible manual opening of the jaws.

Operation. On March 26, 1919, eight months after being injured, and about two months after healing of the wounds, operation for the plastic closure of the aperture in the hard palate was performed. The mode of anæsthesia in this case was the same as employed in Case 1.

With the patient in a similar position to that assumed in Case 1 (see Figures 1 and 2), the edges of the aperture were well trimmed and denuded of scar, as illustrated in Figure 8. Incisions about one-half inch laterally to the aperture, on either side, as shown in Figure 8, were made with a small scalpel completely through to the bone beneath, thus mapping out two plastic flaps, each having two

pedicles, anteriorly and posteriorly. With an appropriate blunt dissector, these flaps were separated from their bony attachments to such an extent that they might be approximated to the center. Internal sutures of silk were then inserted and the aperture was closed in the manner indicated in Figure 9. The wound healed by primary union, all stitches holding. The sutures were removed 6 days after the operation.

Final results. The repair in this case has been perfect, both anatomically and functionally, Plate I, Fig. D. Notwithstanding the fact that the patient was referred to U. S. Army General Hospital No. 3, Colonia, N. J., for arthroplasty of the temporomandibular joint, free motion of the jaw and normal function have resulted. Three months after operation, the patient was discharged, and returned to his home to resume his former occupation.

EPIDIDYMECTOMY, AN IMPROVED TECHNIQUE

By MAXIMILIAN STERN, M.D., New York

IN cases of tuberculosis involving the epididymis, its removal before extension to the gonad has occurred is imperative. The accomplishment of this simple operation is complicated by the possibility of injury to the blood supply of the gonad, which would either impair or eliminate its endocrine value. Stress is laid upon this element in the literature on epididymectomy, but no definite description is to be found whereby this can be avoided. Though the other organ might supply sufficient internal secretion, its future involvement is a frequent occurrence, and the preservation of all gonad tissue is advisable. The illustrations amply describe the operation in detail.

When the removal of a greater length of the vas is indicated Cabot's operation for epididymovasectomy through an additional incision over the internal ring is required. It is then only necessary to free the vas by blunt dissection in the inguinal canal and pull the cut end up and out. Ligating it at the internal ring will in all probability eliminate a tubercular focus beginning in the epididymis. A vas showing disease at this level of the internal ring would be indicative of seminal vesical infection requiring a more elaborate surgical procedure.

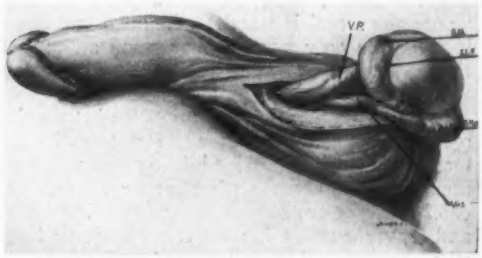


Fig. 1. Vascular pedicle, *v. p.*, is seen in front of vas. Separation exaggerated. Vas is seen to descend to lower pole of gonad, where it swells out (globus minor, *G. min.*) and turns upon itself to terminate at globus major, *G. M.* It lies in front of the vascular pedicle and shows a semilunar fold *S. L. F.*, under which scissors can be inserted, in separating the globus major from the vascular pedicle.

Fig. 2.

Fig. 2. Points of scissors emerging between globus major and vascular pedicle.

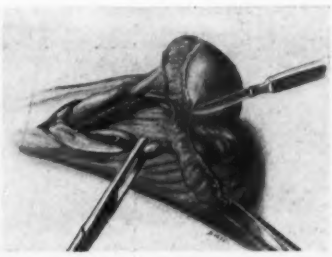


Fig. 3.

Fig. 3. Globus major separated from vascular pedicle. Reflection at globus minor seen.

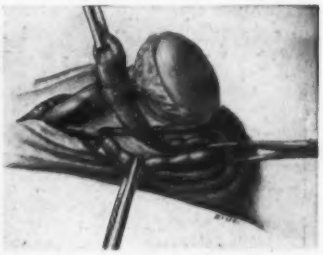


Fig. 4.

Fig. 4. Epididymis freed and ligated.

PROSTATIC-AMBULANT POSTOPERATIVE MANAGEMENT

By A. E. ROCKEY, M.D., F.A.C.S., Portland, Oregon

THE ambulant postoperative management of prostatics is an evolutionary sequence of a simplified operative technique that we have employed for more than ten years. This feature of the plan has been developed by permitting the more favorable cases to move about as they desired, and then seeing the definite advantage to their general well-being, of encouraging the feeble or indifferent to an earlier activity than has been usual. This method of treatment is generally applicable to what might be considered fairly normal cases. The neglected and nearly moribund that require the preliminary drainage of a two-stage operation are, however, not infrequently benefited by a short ambulant period before the gland is enucleated. Such treatment is favorable only when a very small amount of tissue trauma has been caused by the operation.

Prolonged operations do not tend to quick recovery. There has been no change in the technique which I described in SURGERY, GYNECOLOGY AND OBSTETRICS in February, 1913. The chief features are the short suprapubic incision and finger enucleation of the gland; delivery with fenestrated forceps; suspension of the bladder in the space of Retzius by a single catgut suture on each side of the incision; the insertion of a small drainage tube; and most important of all the total abandonment of irrigation.

Postoperative irrigation is a surgical error. It promotes the continuance of bleeding, devitalizes the freshly exposed tissues, and favors the formation of sloughs by removing the blood clot which is the natural hæmostatic and protective of the wound.[1]

A week or ten days postoperative, when the drainage tube is removed, we commonly irrigate once through a rather large soft urethral catheter to wash out any gross detritus that may remain at the bottom of the bladder. At this time one may introduce a cystoscope through the suprapubic wound, and while the water is flowing inspect the healing prostatic cavity. In this way we may easily gain interesting and useful information of the method and progress of recovery. Even when a large gland has been removed, the cavity is reduced to a small cone lined with new granulation tissue. The urethral mucosa is seen at the bottom, and the irregular edge of the bladder margin at the top. Across this zone, healing rapidly advances without irrigation. In a few cases it may be well if the suprapubic opening is slow in closing to safeguard a sufficient patency of the neck of the bladder by the gentle passing of a sound.

The dressing is a simple pad of absorbent cotton, or cellulo-absorbent, covered with a

[1]Rockey. Prostatectomy without irrigation. Boston M. & S. J., 1914 March 12.

Fig. 1. Postoperative prostatics at a friendly game on the roof garden at the Good Samaritan Hospital. Their ages from left to right are 74, 71, and 63.

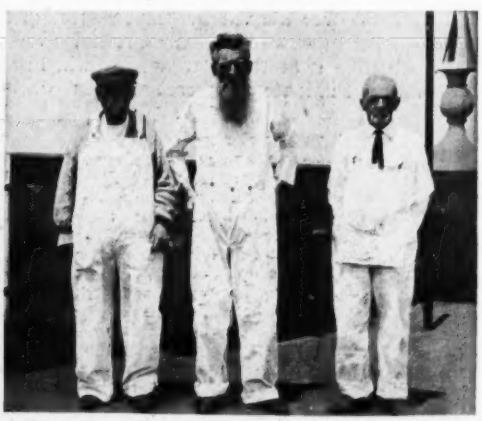


Fig. 2. Postoperative prostatics dressed in painter's overalls, promenading on the roof garden. Their ages from left to right are 83, 78, and 77.

single layer of gauze. The pads are retained with adhesive tie tapes. Over this the ambulant patient wears painter's overalls, of which two or three pairs should be provided.

The patient may be permitted or encouraged to physical effort only as his condition permits. Our usual plan is to have him sit up in bed on the second day, to get up in a wheel chair on the third, and walk about as he pleases on the fourth. He enjoys a game of cards, promenade, or the gossip of the smoking room better than an irksome confinement in bed. The problem of nursing care is much simplified. Figures 1 and 2 illustrate the ambulant plan. Continued experience has demonstrated marked improvement in appetite, sleep, general comfort, and contentment, and a definite shortening of the postoperative period.

A NEW CYSTOSCOPIC TABLE

By HERMAN L. KRETSCHMER, M.D., F.A.C.S., Chicago
Urologist, Presbyterian Hospital; Genito-Urinary Surgeon, Alexian Brothers Hospital

NEARLY all genito-urinary surgeons use the lithotomy or modified lithotomy position in performing cystoscopic examinations and a great many cystoscopic tables have been devised in order to obtain the desired position. This position necessitates the patient's being placed so that the buttocks rest at the edge of the table, the body being more or less semierect, and the legs raised upward, being supported at the knees by knee-rests. This position, to say the least, is very uncomfortable and one that is difficult for some patients to assume, especially those suffering from arthritis or ankylosis of one of the joints of the lower extremity. When patients are in this position for a long time, it is very uncomfortable and occasionally produces more or less distress.

It has always seemed to me that the prone position is a more comfortable one as well as a more natural one for the patient to assume and one that can be obtained in an emergency, on any sort of a table.

Nothing new is claimed for cystoscoping patients in the prone position. To render this position more convenient for routine work the cystoscopic table about to be described was designed.

A new cystoscopic table. *2*, Head rest; *4*, insert for plate holder; *6*, elevator for elevating pelvis.

In its construction it was designed primarily for routine cystoscopic examinations, ureteral catheterizations, various intravesical manipulations, such as fulguration or litholapaxy, as well as for routine irrigations and postoperative dressings.

The standard cystoscopic tables do not sufficiently provide against the soiling of the floor with the wash water that is used for irrigation. Consequently the floor cannot be kept dry and this often aids in producing short circuits. This annoyance has been completely eliminated in our work with this table.

The table was built of a height that would make its use convenient. An elevator is attached for raising the pelvis, which is accomplished by means of a crank attached at the side of the table.

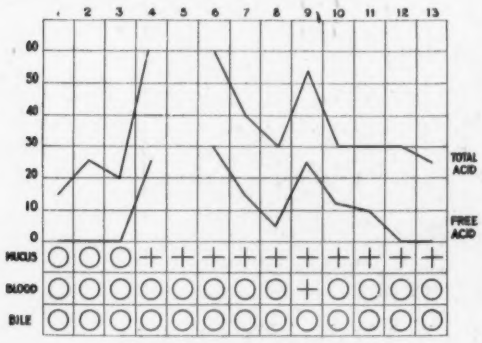
In order that the table may also be used for taking pyelograms without moving the patient from the table, an aluminum insert has been attached, so that a plate-holder may be slipped under the table without disturbing the patient's position. When the table is in use the head-rest is down. The head-rest is used only when pyelograms are to be made.

THE RAMMSTEDT OPERATION IN ADULTS

By HENRY F. GRAHAM, M.D., F.A.C.S., Brooklyn
Assistant Surgeon, Methodist Hospital, and Associate Surgeon, The Norwegian Hospital

THE Rammstedt operation is now generally accepted as the best procedure for nearly every case of infantile pyloric obstruction. It is not so well known, however, that this operation occasionally may be of great value in curing adults who are suffering from pylorospasm and are incapacitated thereby. The following case is reported to illustrate this fact.

S. M., age 46, Italian, married, longshoreman. This patient has suffered from pain in the epigastrium for the past 12 years. It has been worse for the last 2 years. The bowels are costive. He has to take cathartics once or twice a week or he becomes very uncomfortable. His weight is now 146 pounds whereas it formerly was 175 pounds. He has frequently been nauseated and has vomited. He cannot eat meats or acids. He improves for a few months and then becomes worse again. Five years ago he contracted malaria in South Africa. This lasted two years and since then the stomach symptoms have gradually become worse. The pain is worse at night. There is often much distress from gas. The past history is irrelevant. He has never had a chancre.



Rehfuss fractional test.

Physical examination. The man is of medium frame, fairly well nourished. His color is good although like most Italians he is a little sallow. The pupils react to light and accommodation. The teeth are discolored but there is no pyorrhœa. The heart and lungs are normal. The abdomen is scaphoid, with no tenderness, masses or rigidity. Murphy's sign is not present. Reflexes are normal.

The patient entered the Methodist Hospital, January 20, 1919. Blood urea 28.7 milligrams. Wasserman, 1+. The Wassermann was later reported negative by the department of health laboratory. No antisyphilitic treatment had been administered in the interval. The urine was normal. For the Rehfuss fractional test see diagram.

Operation January 23, 1919. Upper right rectus incision. The pylorus was found thickened and cartilaginous with the lumen almost obliterated. The gall bladder, stomach, and duodenum were normal. The appendix was bound down by adhesions and was the seat of an obliterating inflammation. It was removed. There were adhesions also along the ascending colon and terminal ileum.

Dr. Langworthy, who was assisting at the operation, inquired if the Rammstedt operation was ever used in adults. Of course, we were familiar with the Finney and other pyloroplasties, but I could not remember having seen any reports of the use of the Rammstedt operation in such cases. However, this particular case seemed to demand just that particular operation. The pylorus was therefore split down to the mucosa by an incision parallel to the axis of the lumen and about 1 inch in length. The mucosa was then separated from the muscle on the sides for a short distance.

The incision seemed to be slightly longer than was necessary, so a stitch was placed above and below, partially suturing it in the opposite direction from the normal. A small plug of fat was inserted between the muscle ends filling the remaining hole. This plug was held in place by a catgut stitch. These slight modifications we consider unessential. The adhesions along the cæcum and ascending colon were released. The abdominal wall was closed by layer suture. Time consumed by operation 35 minutes.

March 6, 1919. The patient has gained 3 pounds in 14 days. He has suffered from none of the old pain since operation. On June 5, 1919, the patient weighed 146½ pounds. He has had influenza and has lost 5 pounds. On

July 30, 1919, he weighed 150 pounds. "Feel very fine." He eats anything and is at work again as a longshoreman.

December 28, 1919. Patient still remains well.

It might be argued that the pylorospasm in this case was caused by the chronically inflamed appendix and was cured by the appendectomy. I can only say in reply that in my opinion the cessation of pain was too prompt and too permanent to have been caused solely by removal of the appendix. In similar cases I have seen, no such relief was obtained when nothing more than an appendectomy was done.

THE USE OF INTRAMEDULLARY AND EXTRACORTICAL BEEF BONE SPLINTS IN THE REPAIR OF FRACTURES OF LONG BONES

By ADDISON G. BRENIZER, M.D., Charlotte, North Carolina

THE purpose of this paper is not to make a comparison between autogenous, homogeneous and heterogeneous bone grafts. I agree, without discussion, that the autogenous graft, including periosteum, cortex and marrow, taken as one would a slice from a water melon, from another bone of the same individual, is superior in every respect, so far as the grafting material is concerned.

Where there is considerable breech to span, in long bones or between the spinous processes of the spine or in defects of the skull, I should never recommend a heterogeneous graft, but would always use an autogenous graft or, more

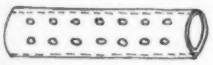


Fig. 1.

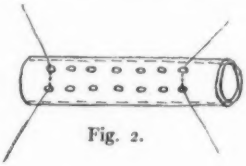


Fig. 2.

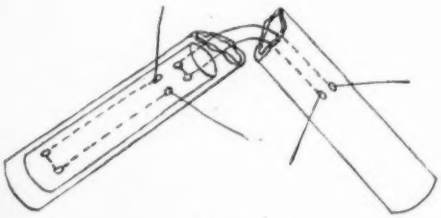


Fig. 3.

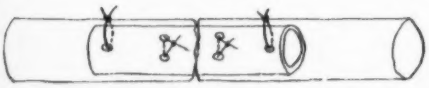


Fig. 4.

Fig. 1. Perforated bone cylinder.

Fig. 2. The cylinder threaded with two sutures of kangaroo tendon.

Fig. 3. The cylinder in place in the medullary cavity of one end of the bone to be splinted. The ends of the suture are seen threaded through two drill holes in each bone end. This drawing demonstrates how the intramedullary cylinder can be pulled across the breech in the bone and from one bone end to the other by drawing on the sutures.

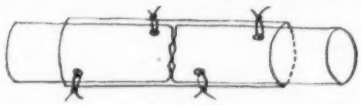


Fig. 5

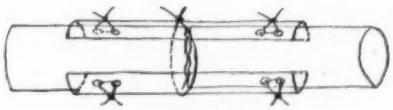


Fig. 6.

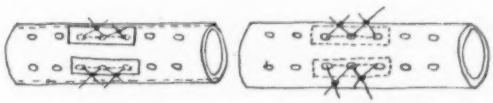


Fig. 7. Fig. 8.

Fig. 4. The cylinder is drawn across the breech into both bone ends and tied in place.

Fig. 5. The application of the extracortical cylinder.

Fig. 6. The application of a part of the circumference of the extracortical cylinder, as a substitute for bone plates, when the bone through callus, scar, etc., is difficult to surround.

Fig. 7. The intramedullary cylinder is armed with four small strips of periosteum and underlying bone, tied to the outside of the cylinder, to be drawn into position across the breech in the bone. The periosteal surface is turned toward the cylinder.

Fig. 8. Shows the same sort of small bone strips, tied to the inner side of the extracortical cylinder, with the periosteal surface against the cylinder.

rarely, a homogeneous graft, from another individual of the same blood group as the one to be grafted.

I do not use the term "beef bone grafts" but rather "beef bone splints," for they are splints, as they are boiled and kept in alcohol until every organic, living cell is dead.

These bone splints are frequently more adaptable, than the sliding graft and often more adaptable than the transplanted autogenous graft. After serving their purpose as splints and as a scaffolding for new formed bone, they are finally absorbed, but they have served their purpose nevertheless.

These bone splints can be used as well as conveyors of small autogenous grafts, where the support and strain falls upon the bone splints, and the bone regeneration upon the small autogenous grafts. This combination of intramedullary and extracortical bone splints and autogenous bone grafts will be described directly.

Two of my patients, I remember well, when I was asking for the privilege of using a graft from the tibia for the radius and ulna, in case I could not make a satisfactory sliding graft, remarked: "My leg is all right now, why trouble it for the arm!" It is sometimes difficult to explain to patients, though it is true, that new bone soon fills the tibia in and the leg becomes strong.

Employing the Albee and Geiger bone sets with their attachments, cylinders of bone taken from the various long bones of older calves and cows, are easily fashioned and can just as easily be adapted at the time of operation. The beef bone cylinders are simply boiled twice for a half hour in 2 per cent sodium solution and kept in alcohol. Before use, they are soaked in sterile salt solution.

LARGE AND SMALL DOSES OF RADIUM

By C. W. HANFORD, M.D., Chicago

THE writer has often stated, and other observers in the field of radium therapeutics have voiced the same thought, that radium is of distinct value in cases of inoperable cancer, particularly of the cervix uteri. And yet recent experiences have shown that some surgeons (?) either do not know when a case is inoperable or use the knife, regardless of consequences. I consider that this attitude is as open to criticism as that of employing escharotics and other agents, after it has been plainly demonstrated that a patient has cancer.

If the surgeon is so anxious to use the knife in a case of cancer of the cervix uteri when possibly the vaginal wall is involved, he should have enough regard for the patient to employ radium in the cervix and vagina until the local lesion is cleared up, at which time the chances for good end-results have increased many times. The time has passed when there is any guess work as to the action of radium rays in malignancy.

Given a case of carcinoma of the cervix, if the patient is not too much weakened by the disease, we can almost promise a clearing up of the local lesion, with the unpleasant accompanying conditions—bleeding, odor and pain—after administering a dosage of 4,000 to 5,000 milligram or millicurie hours.

I am sure that all who have followed radium therapy closely are of the opinion that when the diagnosis of cancer has once been established, it is absurd to temporize with small doses and short applications of radium. It is vitally imperative to strike hard when using radium in malignancy.

If we have a case of cancer of the tonsils, we should not think of giving less than 1,200 to 1,500 milligram hours; and this should be given in a period of two days at least, better at one session. This means if we are using a 50 milligram tube, it is to remain *in situ* at least 24 hours. And again, the tube or needle should not be merely placed against the growth; it should be sunk into the center of the growth and fastened there.

Wherever the dosage and time referred to above is used, there is naturally a slough of tissue in the immediate vicinity of the radium. This commences in about a week or ten days after the treatment, but as the walls of arteries and veins are very resistant to the rays of radium, danger from hæmorrhage, due to the penetration of the walls of vessels, need not concern us.

An illustration of the value of striking hard with radium after the diagnosis of cancer is confirmed by microscopical section, the following case will serve.

The patient, age 47, a farmer from Janesville, Wisconsin, was referred to the writer by T. B. Wiggin, of Chicago. He gave a history of tonsillar affection that commenced 6 months ago. The soft palate became invaded, until finally the existing hole would easily receive an English walnut. This cavity extended back and up some distance. Besides this, one of the cervical glands on the right side of the neck just under the ear was as large as a hen's egg. The patient was totally deaf in the right ear. He had lost 40 pounds in weight and was very weak.

One hundred and eighty milligrams of radium screened to exclude the β-rays were placed in the cavity in the soft palate and stitched in. The radium was left in place for 9 hours. No treatment was given the next day, but the day following, the patient received the same dose for 5 hours. Again a day was allowed to elapse and the day after, the treatment lasted 6 hours, making a total of 20 hours, or 3,600 milligram hours, over a period of 5 days.

The patient went home, returning to the hospital after 12 days. The cavity in the soft palate had markedly narrowed, there was no odor, and even after examination, there was no bleeding. The gland on the side of the neck had diminished one-half. At the first examination, an enlarged gland in the submaxillary region was found; this had entirely disappeared. The patient felt much stronger and more hopeful. He was now given one application in the cavity of 110 milligrams for a period of 6 hours. Also James N. Neff ligated the external carotid, even though improvement had been so marked after the first treatments.

The patient returned home and did not come back to the hospital for a month. He had gained 25 pounds in weight. The hole in the soft palate had nearly closed. There was no sign of the large gland. The patient said he had been doing all of his farm work and never felt better in his life.

Prior to receiving radium treatment he had sought aid at the largest medical and surgical institution in the North West, but was given no satisfaction. A recent letter states that he is nearly back to his normal weight.

Now if temporizing methods had been employed in this case by using 25 or 50 milligrams of radium, the final good result would have been very slow in coming, and I am very doubtful if a definite result would have ever been gained.

MASSIVE DOSES

The writer believes that if he were in possession of 2 or 3 grams of radium, as is the case at a few eastern institutions, he would always speak of massive doses for short periods, for there is no doubt that there is considerable satisfaction in having at hand this large amount of an ultra expensive element. But from a therapeutic standpoint, the application of anything over 200 milligrams of radium element to any one point, is simply for the purpose of shortening the hours of exposure. If we wished to give a uterine fibroid a 1,500 milligram hour irradiation, we would use 100 milligrams of radium for 15 hours. Or if we possessed 500 milligrams in one tube or 500 millicuries (emanation) in a needle, it would be in position but 3 hours.

The writer will concede this point: that in deep malignancy the employment of any dose less than 50 milligrams for a series of hours, is often harmful, in that there is not enough power in the γ-ray content to act as a lethal agent against cancer cells. But, on the other hand, in a zone slightly removed from a small dose of radium, the cancer cells will be whipped into activity, and we have as a result a more grave condition to deal with than if nothing had been used.

The fact that the use of radium in suitable cases does not entail a great loss of tissue commends its use in cases where the radical use of the knife would cause great disfigurement.

The writer's position as regards cancer of the breast is, he believes, held by all who have had more than a passing acquaintance with radium. The surgeon should always have first chance in these cases, but I still believe that the prophylactic treatment with radium at the time of the operation or within a few days after should not be overlooked.

It is natural that only by experience and close observation, can the best results be obtained from so powerful an agent as radium. Because of its innocent appearance, and until recently, lack of information as to dosage, etc., many have been led to believe that they can place the tube anywhere, for indeterminate hours with no fear of untoward results. They are surprised, when the reaction sets in in a week or ten days after treatment, to note an ever increasing area of redness and final destruction of tissue, when the proper application should have produced no more perhaps than a redness. Therefore, I am sure that all radium therapeutists will agree with the writer that each case should be viewed by one thoroughly acquainted with the action of the rays of radium. We have all seen the havoc wrought in the vagina by the too long application of radium and improper screening, thereby causing rectovaginal and vesicovaginal fistulæ.

In treating new-growths with radium, there are some things we cannot expect to accomplish. These include—

Very little benefit in cancer of the tongue, if the glands of the neck and submaxillary region show involvement.

Only temporary improvement in carcinoma of the rectum, especially if of the hard non-vascular type. In some instances the vascular type, if in the middle and upper third, respond fairly well.

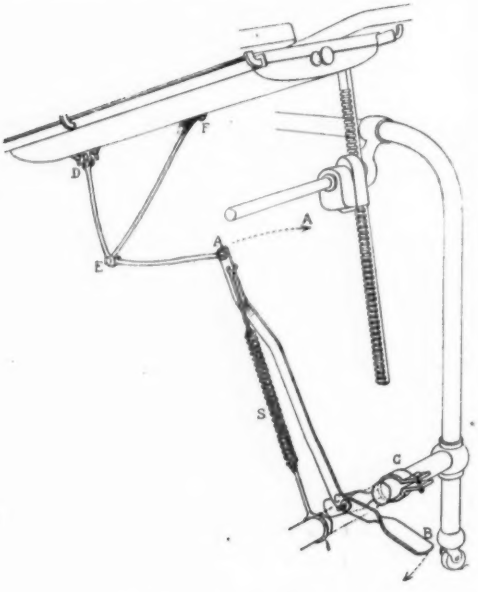
Recurrent cancer of the breast if submitted to radium treatment some months after the operation, show little if any improvement, because the invasion of the lymphatic system is extensive. The time to use radium in breast cancer is immediately after the operation.

PRESENTATION OF A NEW PAN DEVICE ON A CYSTOSCOPIC TABLE[1]

By CHARLES S. LEVY, M.D., Baltimore

PROVISION for drainage of the irrigating fluid used in cystoscopy entails the pulling out of the pan underneath the cystoscopic table. Sterile technique during cystoscopic examination can be maintained by the operator only by having an assistant pull out the drainage pan for him. A device is described here by which the operator himself can bring the pan forward and push it back with his foot.

The apparatus consists of a clamp *G*, a series of levers and a spring *S*. The illustration shows the attachment of these mechanical devices to the lower portion of a Young cystoscopic table The apparatus is so constructed that it is easily attached to any table on the market. It is inexpensive and out of the way.



Pan device for cystoscopic table.

The clamp *G* is attached to the lower leg support of the table, which is usually at the height of 6 to 8 inches from the floor, either in the center or, better still, to the right of the mid line. A lever *A-B* is fastened to the clamp with a fulcrum at *C*, a point behind the bar, and then brought to the center, by bending if necessary. *B* acts as a foot lever, *D* represents the end of the pan, and *F* a point anterior to its center. The rods *D-E* and *F-E* join at *E*, a movable joint. *E-A* is a connecting rod between the main lever, *A-C-B*, and the pan, and the union at *A* may be either a sliding slot or a bolt-screw arrangement, as shown in the diagram. Pressure on the foot-lever *B* tends to bring point *A* forward toward A^1 and of course to bring the pan outward, the extent forward being regulated by the amount of pressure applied by the operator's foot. The device *D-E-A-C-B* will move the pan only in a horizontal plane, but the rod *E-F* is attached to advance the pan upward and forward at the variable heights to which the table is often raised. The spring *S* serves two purposes: in the first place, with the pan back, it has a downward and forward pull, a condition that materially aids in bringing the pan forward; in the next place, as the pan is pulled outward, the spring gradually assumes a downward pull in a vertical direction, a position which tends to lock the pan in place and to prevent it from sliding back when the operator's foot is removed. The pan is made to go back to its original position by elevating the foot-lever with the tip of the shoe.

Such an apparatus is now attached to one of the cystoscopic tables at the Brady Urological Institute and works satisfactorily.

[1] From the James Buchanan Brady Urological Institute, Johns Hopkins Hospital

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

DOCTOR GABRIEL BIDOU'S book reveals a new and personal method of *recuperation for invalids*. He calls it, "Instrumental Orthopedics," and defines it as follows: Instrumental orthopedics is the art of adapting the use of certain appliances to cripples, to replace the action of natural levers of the human body.

He believes that any alteration of the human statics affecting the normal equilibrium, closely involves the co-operation of the other levers of the human body. For example, if a cripple can normally move any portion of his body spontaneously, he will be able, with the aid of certain special appliances, to convert his movement into other movements which are lacking. To illustrate: it means that a paralytic, still possessing free movements of his shoulders will be able to make use of the lateral and lifting movements of his shoulders in such a manner as to transform such into movements of locomotion.

After having given the definition and principle of this new method, Doctor Bidou, in the first part of his book, points out how one would have to proceed to obtain the moral, somatical, and clinical acquirements of the patient, who is to be supplied with an orthopedic instrument. In his work we are witness to the whole evolution of that long observance and of all the scientific researches which will make the diagnosis of the invalid. Later in the book, the author describes the process of turning to account his special instrumentation. He deals with the multiplication and demultiplication of the human efforts, the choice of the levers, the muffling of the tractions. He indicates the various fitting of the artificial limb system which would have to be used, and he recalls several important notions of the physiology of movement.

Finally Doctor Bidou deals with the appreciable services which instrumental orthopedics can render the patient who has suffered an amputation, concerning the wearing of artificial limbs, which are often so difficult to wear because of the poor fitting of the support.

This work, condensed in 132 pages, is the result of considerable research and long experience. The book contains 20 illustrations and photographs of patients supplied with instruments made according to the rules of instrumental orthopedics.

PHILIP LEWIN.

INSTRUMENTAL ORTHOPEDICS. By Doctor Gabriel Bidou. Paris: The Orphan Apprentice School, 1919.

IT is always a pleasure to receive the Collective Papers of the Mayo Clinic.[1] Even though many of these papers have appeared in the prominent surgical journals, nevertheless to read them over again bound in an attractive volume, seems to add to the benefit already derived. Again, many of the articles appeared in journals which are not generally read by the profession at large, and these carry interest which is more than commonplace, since they are the results of investigation by observers and workers of no mean ability after prolonged and intensive study of the subject in question.

This volume includes papers prepared during the year 1918, many appearing in journals in 1919, as late as June. It is of interest to note that the list of contributors numbers forty-six, and the subject matter covers a most varied field of investigation. Aside from the ever interesting contributions on purely surgical topics by William Mayo, Charles Mayo, Judd, Balfour, Sistrunk, Masson, and others, there appears a number of most unusual papers on subjects which are more or less in the field of experimental research. The work of Luden, on "Studies on Cholesterol," Kendall on the "Thyroid Hormones," and Mann on "Experimental Study of Shock," show an immense amount of work, close observation to detail, sound judgment, and mature deductions. The masterly articles of Stokes on the "Cutaneous Aspect of Tuberculosis" deserve especial mention. He calls attention to the close association of certain skin lesions to tuberculosis, which, so far as the reviewer is aware, is entirely new and warrants consideration not only in diagnosis but in treatment.

It is, indeed, difficult to pass over any paper without saying something, as in each there is a breath of life and hope for the sufferer, a something which extends a helping hand in bridging a dangerous and turbid stream.

JOHN A. WOLFER.

DURING the recent years we have heard much of plastic surgery. Many surgeons are doing so-called plastic surgery and unfortunately many failures result. The reason is possibly twofold: first, a man must have had special training in this technical branch of surgery; and, second, he must have, one might call it, preternatural ability for

[1] COLLECTED PAPERS OF THE MAYO CLINIC, ROCHESTER, MINNESOTA. Edited by MRS. M. H. Mellish. Vol. x, 1918. Philadelphia and London: W. B. Saunders Company, 1919.

PLASTIC SURGERY, ITS PRINCIPLES AND PRACTICE. By John Staige Davis, Ph. B., M. D., F.A.C.S. Philadelphia: P. Blakiston's Son & Co., 1919.

this kind of work. To visualize and devise methods in plastic work is not merely a matter of training and the doing of so much routine operating. There lies behind all a certain adroitness, a dexterity, combined with vision. On the technical side, very little new has been brought forth in recent years. What appears new is mostly a new application of some time-honored procedure. This ability to apply a certain procedure to cope with a condition successfully, is the essential of a plastic surgeon. One cannot overcome this conviction in reading the recent excellent work on this subject. The author who possesses the fortunate combination of training and plastic vision, has given the profession a valuable contribution. It is the reviewer's belief that the study of this work on plastic surgery by a surgeon will not of necessity make him a plastic surgeon, but may perchance prevent many surgeons from doing plastic surgery; it may be the means of developing, in an individual who has the inherent and artistic knack for this type of work, the ability to do plastic work. There is no question but what every surgeon must utilize plastic methods of some description in his operative work and to improve this technique, it is to every surgeon's advantage to seek counsel with the plastic surgeon.

The author after a historical review and a discussion of general considerations, describes the various methods of transplantation of skin and other tissues. A chapter is devoted to the treatment of wounds, since proper wound treatment might be called the prophylactic phase of plastic surgery. In successive chapters the principle of transplantation is applied to various conditions including malformation, such as harelip, cleft palate, exstrophy of the bladder, epispadias, hypospadias, atresia of vagina, and the like. Most of the text is devoted to work about the face, as here the demand for plastic surgery is the greatest, either in the treatment of acquired or congenital defects. A complete bibliography is given at the close of each chapter.

The work as it stands today is the most complete of any on the subject of plastic surgery, and justly deserves close study. Many of the principles outlined can be used daily in routine operative work, to make general surgery neater and less mutilating. For the plastic surgeon it is his handbook and counsel. JOHN A. WOLFER.

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE OPERATIVE STORY OF GOITER; THE AUTHOR'S OPERATION. By William S. Halsted, M.D. Baltimore: Johns Hopkins Press, 1919.

A MANUAL OF OBSTETRICS. By Edward P. Davis, A.M., M.D., F.A.C.S. 2d ed. revised. Philadelphia and London: W. B. Saunders Company, 1919.

A MANUAL OF OBSTETRICS. By John Cooke Hirst, M.D. Philadelphia and London: W. B. Saunders Company, 1919.

ATLAS OF OPERATIVE GYNECOLOGY. By Barton Cooke Hirst, M.D. Philadelphia and London: J. B. Lippincott Company, 1919.

THE PREVENTION OF DENTAL CARIES AND ORAL SEPSIS. By H. P. Pickerill, M.D., Ch.B.M.D.S. (Birm.), L.D.S. (Eng.). New York: Paul B. Hoeber, 1919.

THE PRACTICAL MEDICINE SERIES. Vol. ii, General Surgery, edited by Albert J. Ochsner, M.D., F.R.M.S., LL.D., F.A.C.S. Chicago: The Year Book Publishers, 1919.

A TEXTBOOK OF UROLOGY IN MEN, WOMEN AND CHILDREN, INCLUDING URINARY AND SEXUAL INFECTIONS, URETHROSCOPY AND CYSTOSCOPY. By Victor Cox Pedersen, A.M., M.D., F.A.C.S. Philadelphia and New York: Lea & Febiger, 1919.

ROENTGEN INTERPRETATION; A MANUAL FOR STUDENTS AND PRACTITIONERS. By George W. Holmes, M.D., and Howard E. Ruggles, M.D. Philadelphia and New York: Lea & Febiger, 1919.

THE AMERICAN ILLUSTRATED MEDICAL DICTIONARY. A new and complete dictionary of the terms used in medicine, surgery, dentistry, pharmacy, chemistry, nursing, veterinary science, biology, medical biography, etc., with pronunciation, derivation, and definition. By W. A. Newman Dorland, A.M., M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1919.

A REPORT OF THE SCIENTIFIC WORK OF THE SURGICAL STAFF OF THE WOMAN'S HOSPITAL IN THE STATE OF NEW YORK, 1919.

DIE INDIKATIONEN ZUR KUENSTLICHEN UNTERBRECHUNG DER SCHWANGERSCHAFT. By Prof. Dr. G. Winter. Berlin and Vienna: Urban & Schwarzenberg, 1918.

DIE ERHALTUNG DES KINDESLEBENS IN DER GEBURT. By Prof. Dr. Walther Benthin. Berlin and Vienna: Urban & Schwarzenberg, 1919.

THE EXACT DIAGNOSIS OF LATENT CANCER. By O. C. Gruner, M.D. Philadelphia: P. Blakiston's Son & Co., 1919.

INGUINAL HERNIA; THE IMPERFECTLY DESCENDED TESTICLE AND VARICOCELE. By Philip Turner, M.S., F.R.C.S. London: J. & A. Churchill; Philadelphia: P. Blakiston's Son & Co., 1919.

LES LÉSIONS DES NERFS. TRAITEMENT ET RESTAURATION. Paris: Masson & Co., 1919.

ANESTHÉSIE À LA STOVAINE EN CHIRURGIE ET EN MÉDICINE VÉTÉRINAIRE. ANESTHÉSIE RÉGIONALE; ANESTHÉSIE LOCALE. Paris: Masson & Co., 1919.

THE SURGERY OF EGYPT. By Frank Cole Madden, O.B.E., M.D. (Melb.), F.R.C.S. (Eng.). Cairo: The Nile Mission Press, 1919.

THE PRINCIPLES OF NURSING. By Charlotte A. Brown, R. N. Philadelphia and New York: Lea & Febiger, 1919.

OXFORD LOOSE-LEAF SURGERY. By various authors. Edited by F. F. Burghard, M.S. (Lond.), F.R.C.S. (Eng.), Colonel, A.M.S.; and Allen B. Kanavel, A.B., M.D., F.A.C.S., Colonel, M.C., U.S.A. Vols. ii to v. New York: Oxford University Press, 1919.

DIE OERTLICHE BETAEUBUNG, IHRE WISSENSCHAFTLICHEN GRUNDLAGEN UND PRAKTISCHE ANWENDUNG. By Prof. Dr. Heinrich Braun. Leipzig: Johann Ambrosius Barth, 1919.

INDEX-CATALOGUE OF THE LIBRARY OF THE SURGEON GENERAL'S OFFICE. Authors and Subjects. 3d Series. Vol. i, A-Army. Washington: Government Printing Office, 1918.

THE NUTRITION OF THE FOETUS. By J. Morris Slemons, M.D., New Haven: Yale University Press, 1919.

REPORT OF THE SURGEON GENERAL, U. S. ARMY, TO THE SECRETARY OF WAR, 1919. 2 vols. Washington: Government Printing Office, 1919.

CORRESPONDENCE

SURGERY OF TENDON TRANSPOSITION

To the Editor: Dr. Bernstein's paper "The Surgery of Tendon Transposition" published in the July number of SURGERY, GYNECOLOGY AND OBSTETRICS, deserves the study of all interested in tendon surgery. Just because of the thoroughness and care shown in its preparation, a word of criticism may not seem amiss. Dr. Bernstein divides the operations for tendon transfer into three types: in the first the tendon pursues a subcutaneous course, in the second (the Biesalski-Mayer technique) it is drawn through the sheath of the paralyzed tendon, in the third it is transposed with its own sheath. It is of the two latter that I wish to write, since my views concerning the first are in accord with Dr. Bernstein's.

Dr. Bernstein condemns the technique proposed by Biesalski and myself because, according to his animal experiments, adhesions form between the transplanted tendon and the sheath of the paralyzed tendon through which it is drawn. It is, indeed, true that at a secondary operation performed 17 days after the original transfer, I found delicate bands within the tendon sheath but these bore no resemblance to those depicted in Dr. Bernstein's microphotographs, nor were they clinically of sufficient strength to impede the free gliding of the transplanted tendon. The explanation of this discrepancy in our findings is probably due to the fact that the Biesalski-Mayer technique is far more difficult of exact execution on a dog than on the human patient, since owing to the minute size of the canine tendon sheath, more traumatism is almost certain to occur. It is possible also that Dr. Bernstein has not been using all the refinements of technique which have been introduced since my original publication.

One fact stands out quite definitely as a result of more than 250 operations, and that is that clinically, the tendons which are transferred by the intrasheath method function with hardly any exception almost as well as the normal.

The third method, namely the transfer of the tendon with its sheath has my full approval as an alternative method. This is a natural feeling on my part since Biesalski and I published this same technique over three years ago; it is to be found with illustrations in our monograph on "Tendon Transplantion," page 251 *et. seq.* It seems, therefore, to me somewhat unwarranted on Dr. Bernstein's part to consider this method particularly his own. My sole objection to it is its limitation to two or at most three operations. It is quite impossible to apply it to the transposition of the peroneous longus for a paralyzed tibialis anticus since the sheath of the peroneus longus is much too short. For the transfer of the extensor proprius hallucis, the method is adequate and has given excellent clinical results in all the cases in which I have employed it. Dr. Bernstein must not, however, think this technique preserves the blood vessels of the mesotenon intact; although the sheath is not opened, many of these vessels must be divided before the tendon sheath can be lifted away from the bone.

I wish again to emphasize what I have written in previous publications; that the physiological method is a term proposed for any technique in which due cognizance is taken of the normal anatomy and physiology of tendons. It is deeply gratifying to me, that Dr. Bernstein, Dr. Steindler and above all Dr. Bunnell, stimulated by modern tendon research, are trying to improve the methods proposed by me and through our united efforts further gain is certainly to be looked for.

LEO MAYER, M.D.

New York City

THE GAS DUMB-BELL

A Device for the Relief of Postoperative Flatus

To the Editor: Some seven or eight years ago I was operated upon for double inguinal hernia. On the day after the operation I began to be distressed by gas accumulations which would pass down into the rectum but which I could not expel because of total inability to use the abdominal muscles to overcome sphincter resistance. After a time the gas would gurgle back up into the colon and the tension become quite painful.

The usual rectal tube (of rubber) was inserted but furnished little relief, due, I discovered, to the fact that it curled up in the rectum. I called for a glass douche tip and found that by passing it just through the sphincter, easy outlet was provided for gas every time it was forced down into the rectum and thus large accumulations higher up were avoided. The distress disappeared.

The only drawback to the douche tip was that it easily slipped out and had to be frequently reinserted. This set me to thinking and I conceived the idea of having a tube made of glass in the shape of a dumb-bell which could be inserted through the sphincter and would be self-retaining, one bulb preventing it from slipping in and the other from slipping out. Having then passed the flatus period I did not have the chance of trying it out on myself, but as soon as I resumed my work I had a number of the dumb-bells made and have used them ever since on my postoperative cases with entire satisfaction. Inserted early — as soon as flatus begins to collect — they will provide complete relief in nearly every case, and they may be left in place any length of time without producing any discomfort whatever.

A supply of the tubes was provided for the use of Base Hospital No. 22 in France, where they had a good trial, and they are now in use in several of the hospitals here in Milwaukee.

Philip F. Rogers M.D. F.A.C.S
Milwaukee, Wis.

AN APPEAL FOR HUMAN EMBRYOLOGICAL MATERIAL

To the Editor: In 1906 I observed certain malformations of the human shoulder-blade, and in contributions to current literature I have given them the collective name "the scaphoid type of scapula," and pointed out some of its hereditary, clinical, and anatomical significance.

Probably the most important observation connected with this type of scapula in man is its age incidence, that is to say, it occurs with great frequency among the young and with relative infrequency among the old. There appear to be two possible explanations of this fact; either (a) one form of shoulder-blade changes into the other during development and growth; or (b) many of the possessors of the scaphoid type of scapula are the poorly adaptable, the peculiarly vulnerable, the unduly disease susceptible—the inherently weakened of the race.

I have attempted to answer these questions by seeking evidence in various directions, and one of the most important of these has been a study of intra-uterine development of shoulder-blades. My investigations in this direction have been limited by the material at my disposal, which has been inadequate for a definite solution of this phase of the problem. I am, therefore, appealing to physicians for fœtus in any and all stages of human development.

It is desired that the material, as soon as possible after delivery, be immersed in 10 per cent formalin in a sealed container, and be forwarded to my address; charges collect. Due acknowledgment will be made to those forwarding material.

William W. Graves, M.D.
Metropolitan Bldg.,
St. Louis, Mo.

AMERICAN COLLEGE OF SURGEONS

THE NEW ADMINISTRATIVE HOME

On December 30th, 1919, final payment was made on the new administrative home of the American College of Surgeons and a deed to the property in the name of the College was delivered to its officers. This magnificent present to the College was a direct gift from citizens of Chicago —three-fourths of the amount subscribed by public-spirited men and women, and one-fourth by a group of the Chicago Fellows.

We take great pleasure in printing the names of the donors as they appear on the two rolls of honor:

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REQUIREMENTS FOR FELLOWSHIP

1. The candidate shall be a graduate of medicine, licensed to practice medicine in his respective state or province, or accepted as a medical officer in the service of his country.

2. To be eligible for Fellowship without technical examination the candidate shall be a graduate of a medical school approved by the American College of Surgeons. If the candidate's school of graduation is not accredited by the American College of Surgeons, he may be required to pass a technical examination in one or all subjects of the medical curriculum.

3. The candidate shall give evidence that he has served at least one year as an interne in a creditable hospital and two years as a surgical assistant, or he shall give evidence of an apprenticeship of equivalent value. Five to eight years after graduation in medicine, devoted to special training and to practice, are normally the time-requirement for eligibility to Fellowship. Due importance is attached to laboratory and research work.

4. The ethical fitness and integrity of the candidate and his professional attainment shall be passed upon by the Credentials Committee of his state or province before he is entitled to take the examinations for admission to Fellowship as hereinafter described. To aid the Committees in this work, the Fellows of the College are asked from time to time for definite and impersonal reports concerning candidates in their respective states and provinces.

5. The professional activity of the candidate shall be limited to the study, diagnosis, and operative work in such specialty or specialties of surgery as the candidate may himself designate, as follows: First, if the candidate resides in a city of less than fifty thousand inhabitants, at least fifty per cent of his professional activity shall be limited to the study, diagnosis, and operative work in such specialty or specialties as stated. Second, in cities of over fifty thousand inhabitants, at least eighty per cent of the professional activity of the candidate shall be so limited.

6. The candidate shall make formal application for Fellowship. Blank forms for this purpose may be had, upon request, from the Secretary General of the College.

7. In making application for Fellowship the candidate shall sign a declaration which reads as follows:

"I hereby promise upon my honor as a gentleman that I will not, so long as I am a Fellow of the American College of Surgeons, practice division of fees in any form; neither by collecting fees for others referring patients to me; nor by permitting them to collect my fees for me; nor will I make joint fees with physicians or surgeons referring patients to me for operation or consultation; neither will I in any way, directly or indirectly, compensate any one referring patients to me; nor will I utilize any man as an assistant as a subterfuge for this purpose."

8. Surgeons widely recognized by the profession as leaders of progress and exponents of finished technique, by a unanimous vote of the Board of Regents, may be admitted to Fellowship on recommendation of the Committee on Examinations. Personal candidature for Fellowship on this basis, however, is not entertained. All candidates for Fellowship are requested to make formal application as described under Articles 6 and 7.

9. The examination in the art and technique of surgery consists of, first, fifty complete case-records to be submitted by the candidate of major work performed by himself; second, fifty case-records in brief abstract of major work for which he was responsible or in which he acted as assistant. For requirements in ophthalmology, see Article 10.

In order that this requirement be more explicit, the College has prepared a series of record forms which indicate, in a general manner, the data desired in so far as they are applicable to each case, and the form within reasonable limits in which these data should be submitted. These record forms are printed in Bulletin No. 2, Vol. IV. The College does not supply these forms.

The essential data for the fifty complete case-records are the identification of the case by number—the name need not be given; date of operation; personal history relevant to complaint; physical examination; diagnosis on which operation was based; operative record, findings at operation, and technique; laboratory and physical findings; post-operative diagnosis; complications of convalescence; follow-up record in so far as available. A summary of each case, as explained later, is also desired. The essential data for the fifty case records in abstract are the identification of the case by number and other data as outlined on the summary card (Form 1).

10. In addition to the general requirements for admission to Fellowship (except Article 9), the examinations in ophthalmology consist of, first, case-records; second, written examinations; and, third, clinical laboratory and oral examinations, or so much thereof as may be judged necessary:

a. Candidates in ophthalmology are required to submit twenty-five complete case-records in accordance with Article 9. Ten of these records should be of cases of ocular diseases and defects of varied character, including errors of refraction or muscle balance; external ocular diseases or diseases of the uveal tract or retina, or of the optic nerve, or glaucoma. The reports should show especially the reasons for the diagnosis and for the operative treatment, and the technique of operations.

b. The written examination will test the candidate's knowledge of the underlying principles or science of ophthalmology, including anatomy, embryology, physiology, physiologic optics, pathology, relations of the eye to other organs and diseases of the body.

c. The oral examination will include:

The external examination of the eye.

Ophthalmoscopy. (Candidates are requested to bring their own ophthalmoscopes.)

Measurements of errors of refraction.

Testing of the ocular movements and fields of vision.

Relations of ocular conditions to diseases of other parts of the body and their treatment.

Laboratory examination in histology, pathology, and bacteriology of the eye.

d. The time and place of examination will be determined from time to time by the Ophthalmic Credentials Committee.*

11. The Regents of the College reserve the right to alter, from time to time, regulations respecting the admission of Fellows to the College as they may deem proper.

FELLOWSHIP FEE AND DUES

The initial Fellowship fee and dues are stated under the two following provisions:

1. That the initial Fellowship fee of the College is $100, payable upon notification of election to Fellowship. The initial Fellowship fee of candidates whose applications were filed at the executive offices of the College before November 1, 1914, is $50.

2. That annual dues of the College are provided as follows:

a. That the annual dues of the Fellows of the College be $25, payable January 1.

b. That all Fellows who have subscribed $500 to the Endowment Fund of the College be exempt from annual dues.

c. That the total amount required in annual dues or other fees shall not exceed $500.

d. That the Board of Regents cancel the indebtedness of any Fellow of the College, without publicity, to whom, in its judgment, such dues are a hardship.

e. That no Fellow of the College be asked to contribute any fee whatever to the College, either after 65 years of age, or after he has retired from active practice.

*The Ophthalmic Credentials Committee of the College and the American Board for Ophthalmic Examinations are the same body. The personnel of this committee is: Representatives of the Section on Ophthalmology of the American Medical Association, Dr. Edward Jackson, Chairman, Denver, Dr. Edward C. Ellett, Memphis, Dr. William C. Posy, Philadelphia; of the American Ophthalmological Society, Dr. Hiram Woods, Baltimore, Dr. Myles Standish, Boston, Dr. John E. Weeks, New York; of the American Academy of Ophthalmology and Oto-Laryngology, Dr. William H. Wilder, Chicago, and Dr. Walter B. Lancaster, Boston.

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CONFERRED AT THE SEVENTH CONVOCATION, NEW YORK, OCTOBER 24, 1919

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SIR ROBERT JONES, K.B.E., C.B., D.Sc., F.R.C.S., Liverpool, England
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